The New Zealand
Journal of Agriculture.

VOL. 45. WELLINGTON, 20TH DECEMBER, 1932. No. 6.

SOILS OF THE NEW ZEALAND SEA LITTORAL AND THEIR PLANT COVERING.

B. C. ASTON, Chief Chemist, Department of Agriculture.

THE classification of soils on a continental scale is usually based on the situation with reference to climate and its effects; on a smaller scale the classification rests more on the physical or chemical properties of the soils. The coastal districts of New Zealand, and those owing their warmth to the proximity of the sea, have a similarity of climate which enables this important factor to be disregarded generally. The great majority of New Zealand soils fall into the second of two great classes proposed by the Russian school of soil chemists (Glinka and others), the skeleton, immature, or mineral soils, of which very little is known. In other words, in New Zealand the particles composing the soil have been insufficiently weathered since the time they were broken from the parent rock, to which the soils are more akin than to those mature soils of the continents.

Of the physical and chemical characters—since the majority of New Zealand soils are derived from but a few rocks such as the greywacke and the volcanic rocks, well supplied with plant-food—the physical state of the soil which determines the capacity for holding water is of superior importance to the knowledge of the plant-food content. In other words, whether a soil is a fine gravel, a coarse sand, a fine sand, a clay, or a mixture of these usually called a loam, is what as a rule determines soil value to the farmer. The dictum of Sir Daniel Hall and Sir John Russell that "in the main it is the structure of the soil as revealed by the mechanical analyses which determines the adaptability of the soil to a given crop" should be the guiding light in New Zealand soil studies.

Obviously a third method for determining the quality of soils should be available in which the various forms of life which occur in the soil or grow on it are taken into account as indicators of the quality of the medium from which they draw their food, except carbon in the case of the higher plants. The study of microflora and microfauna of soils is in its infancy, and nothing can now be said as to the value of these low forms of life in diagnosing the quality of

fertile soils. The value of the higher plant covering as a means for determining the agricultural possibilities of lands was pointed out by Hilgard in his classic work on American soils (1906), in which a chapter is devoted to "The Recognition of Character of Soils from their Native Vegetation." Original survey maps of the New Zealand Lands Department always show the kind of forest growing upon lands surveyed by the Government, and undoubtedly the plant covering has been taken into account in assessing the probable value of land for settlement. In the 1907 Report of the Department of Agriculture, the writer stressed the importance of taking the plant covering into account in any systematic research on soils, and in the 1909 Report, p. 457, referred to a flying soil survey in the sub-Antarctic islands of New Zealand where the soils are differentiated by means of the plant covering (see this *Journal*, Jan., 1911, p. 10). Here was given in some detail the results of the survey, indicating that the plant covering is a sure guide to the qualities of the soil in the Lord Auckland Islands (see "Sub-Antarctic Islands of New Zealand," Government Printer, 1909).

Again, in the soil survey of the Patatere Plateau, north-west of Rotorua (see this *Journal* for June, 1926, p. 365), on a large area of country having similar topography and climate, it was possible to correlate soil texture with primitive plant covering which in this case was forest, the usual climax of vegetation, tawa-rimu forest, occurring on the coarser soils, and beech forest on those which had a larger proportion of fine particles.

In the following pages it is intended to deal with the characters of sea littoral soils which as a class present many points of theoretical and practical interest. Littoral pastures are well known to provide better grazing than inland pastures on the same kind of soil, and the reason for this is worthy of a passing thought. It will be found on examination that land plants which succeed in growing in situations which at any time may be charged with salt water from the sea, and at all times are exposed to strong light and often to heavy winds, have adopted special contrivances which enable them to tide over periods of saltness or dryness of soil or air until these conditions disappear.

The exact means by which plants are able to tolerate a large quantity of salt in the soil need not be discussed, but it will be sufficient to say that the most prominent sign of the sea littoral plant is extreme succulence of habit due to storage organs containing water, which enables the plant to exist without taking up the salt water in the soil surrounding the plant roots. The soil is then said to be physiologically dry, or, to put it another way, on seashores the water may be at times unavailable to the plant owing to saltness, while in deserts there is deficiency of water of any kind, fresh or salt. Other structural adaptations which enable plants to tide over a period of adverse dry conditions are extreme leatheriness of leaf texture or great hairiness of leaf surface, both resorts of the plant to diminish transpiration from the tissues of water, which is hence better conserved. The plants which can only produce thin large leaves adapted to transpire copiously are never found in the vegetation of maritime shores where they may be exposed to excessive salt, strong insolation, and drying winds.

It should be here pointed out that salt blown inland as sea spray has a short life in the soil, even when quite near to the sea, and the soil on analysis will show very little contained salt. This is due to the fact that, in addition to the loss by leaching in the drainage, moderate doses of salt are changed in the soil, where a double decomposition of soil-matter and salt takes place, so that little chlorine is found on analysis. A number of plants which are regarded as sea littoral plants entirely are found on the shores of the great lakes, and also in inland situations, where they have adapted themselves to the new environment completely. Thus *Selliera radicans*, *Ranunculus acaulis*, and *Calystegia Soldanella* grow on pumice beaches in the North Island lakes, while the last named may be observed growing quite well in railway ballast on the railway-line near Upper Hutt station, the seeds having evidently been transported from the coast in the gravel.

Common salt (sodium chloride) is undoubtedly able to liberate plant-food from the inert silicates of the soil, which, after being acted upon by the carbonates of soda probably formed, is decomposed into compounds more available to the plants. There is evidence that in this way phosphates are attacked and rendered more soluble in weak citric acid and leached out of the soil. Potash certainly is liberated and no doubt calcium, while iron is leached out and redeposited as a pan or hard layer. Sodium carbonate acts as a deflocculating agent enabling the finer particles to be washed away and deposited elsewhere. General increase of the mineral fertilizer elements would no doubt lead to increase of the available nitrogen in the soil, hence result in better pasture. The presence of salt in the soil is inimical to many pests that feed on plants. On the whole, therefore, salt in the right quantities may be extremely beneficial to land when the type of soil is a light one. On clays and heavier soils the action of salt may be injurious. If, however, the amount of salt in the soil is very large—for instance that introduced by intermittent submersion by tides and the subsequent drying-out of the water—the salt accumulates to such an extent that only purely halophytic plants such as salt-weed (*Salicornia*) can grow on it.

Plant Indicators.

In the North Island there is current among experienced farmers who have had the opportunity of observing the "breaking-in" of various types of country, a tradition (which will be dealt with at length later) concerning the quality of the soil as indicated by the primitive plant covering. Thus totara (*Podocarpus totara*) is an indication of stony soil and subsoil, but matai (*Podocarpus spicatus*) is always found on rich land and is a sign of dry land when growing in close stands. Pukatea (*Laurelia novæ-zealandiæ*) is a sign of good land, but perhaps one of the best indicators of good land is mahoe (whitey wood) (*Melicytus ramiflorus*). Perhaps the best sign of all in indicating goodness of land is the New Zealand vine or Pohuehue (*Muehlenbeckia australis*) when present in abundance. Supplejack (*Rhipogonum scandens*) is another liane which also betokens superior quality of soil. On the other hand, rimu (red pine) (*Dacrydium cupressinum*) is a sign of sour land. Tawa (*Beilschmiedia tawa*) indicates good land when the leaves are a healthy and bright green colour, but when the leaves are yellowish it often

signifies poorer quality soil, tawa being the predominant tree of much of the forest-clad pumice lands. Kahikatea (white pine) (*Podocarpus dacrydioides*) betokens swampy conditions. Tawhero (*Weinmannia racemosa*) and beech (*Nothofagus* sp.) are indicative of much poorer land than occurs with Podocarp-tawa forest, and when cleared the land is left in bad condition, and grass will not grow well for five years or so. Certain other plants show mildness of climate; passion-flower (*Tetrapathoea tetrandra*), nikau palm (*Rhopalostylis sapida*), puriri (*Vitex lucens*), and New Zealand mahogony (kohekohe) (*Dysoxylum spectabile*) always occur where there is very little frost. In the far North, kauri forest indicates the poorest soil, but tall manuka is evidence of good land.

A host of plants are characteristic of the sand dunes, and have evolved a habit of growth necessary to guard against premature burial by the wind-blown particles. The truth that marsh swamp or bog plants indicate wet soil is too obvious to be stressed.

In the case of sea littoral soils there appears to be a distinct gradation in the tolerance which land plants exhibit towards soils containing varying proportions of salt. Thus nearest to the salt water of tidal inlets, on land subject to periodical submergence by sea water at times of exceptional high tides, grows the salt weed (*Salicornia*). To the landward of this, very often closely associated, are such plants as *Scirpus maritimus* or *Chenopodium glaucum*, and as the salt diminishes *Cotula coronopifolia* and many other plants are ready to occupy ground only slightly salty, such as the introduced sow-thistle (*Sonchus* sp.), &c. Evidently this is another case of change of chemical composition of soil being indicated by a change in the plant covering.

Perhaps the most striking instance of the influence of soil composition on the vegetation is that of the Dun Mountain, Nelson, where the change from beech forest to scanty scrub is coincident with the great change in the magnesia content of the soil (see this *Journal*, December, 1915, p. 500, and Bulletin 12, Geological Survey, p. 5.).

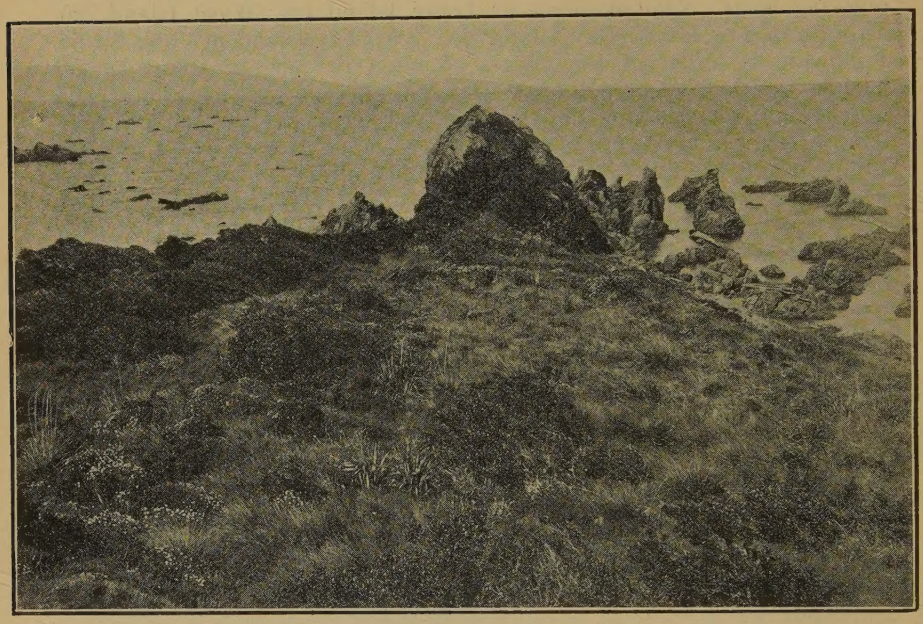
Naturally this method of diagnosis of soil quality from an inspection of the land covering is best performed in primitive areas where the competition between plants has been going on for ages without interference by man. Recently the question has been asked why certain areas of scrub lands on the Kaingaroa Plains are populated by monoao (*Dracophyllum subulatum*) in pure association and other areas nearby by an entirely different mixture of shrubs, a most striking difference even to the casual observer passing by. This is probably more a frost effect than one due to soil change, the monoao often occupying depressions. Similar changes in adjacent districts in vegetation have also been noticed which can only be due to frost effect.

The littoral soils about Wellington may be best studied on the small spray-swept islands, whether these occur in the harbour or outside. These all exhibit a similarity of an indigenous plant-covering which would enable a skilled observer to say that the area was a typical littoral soil, and analyses of the soil would show that the plant-foods were present in higher proportions. All the following islands have been carefully inspected and a note taken of their florulas: Kapiti and its outlying islands—Motungarara or Hiko Island (*m*), Tokomapuna or Evans Island (*e*), Tahoramaurea or Mayhew Island (*t*); Mana

Island; the islands in Wellington Harbour—Somes Island and its outlying islets, Ngamokopuna or Leper Island (*n*), Ward Island (*w*), Taputurangi or Island Bay Island (*i*); Stephens Island in Cook Strait. Following is a list of the plants common in each of these smaller islands, which from their limited area and exposed position afford good opportunity for studying the results of sea spray, intense sunlight, and wind action. The letters placed after the name of each plant indicate the names of the different islands (as named above) on which it occurs. The larger islands—Kapiti, Mana, Somes, and Stephens—are omitted, as they are so comparatively extensive and partially forested that they probably escape in great part the unusual conditions which affect the vegetation on the smaller islands.

Ranunculus acaulis : *m, n.*
Cardamine hirsuta : *i, t, m, e.*
Hymenanthera crassifolia : *m, i, n, e.*
Colobanthus Muelleri : *i, w, n.*
Spergularia media : *m, e, i, n, w.*
Linum monogynum : *m, e, i, n.*
Acæna sanguisorbæ : *m, w.*
Tillaea Sieberiana : *e, m, t, i, n.*
Haloragis alata : *m, n, e.*
Mesembryanthemum australe : *m, e, w, i, n.*
Tetragonia trigyna : *m, e, w, i.*
Hydrocotyle moschata : *t, w, m.*
Apium prostratum : *m, e, w, i, n.*
Coprosma Baueri : *w, n, i, m.*
Coprosma propinqua : *e, m, i.*
Gnaphalium luteo-album : *m, w, n, i.*
Cassinia leptophylla : *m, t, w, n, i.*
Craspedia uniflora : *n, i.*
Cotula coronopifolia : *m, n, i.*
Cotula australis : *t, m.*
Senecio lautus : *m, e, n, w, i.*
Sonchus asper (*var.* littoralis) : *n, w, i.*
Selliera radicans : *n, i.*
Lobelia anceps : *n.*
Wahlenbergia gracilis : *n, m.*
Samolus repens : *i.*
Calystegia Soldanella : *m, e, n.*
Dichondra repens : *n, e, w.*
Veronica salicifolia (*var.* Atkinsoni) : *n, w, m.*
Myoporum laetum : *m, e.*
Scleranthus biflorus : *m, n.*
Rhagodia nutans : *m, e, w, n, i.*
Salicornia australis : *m, e, w, n, i.*
Muehlenbeckia complexa : *m, e, t, w, n, i.*
Pimelea laevigata : *m, n, i.*
Phormium Cookianum : *m, t, n, i, e, w.*
Juncus effusus : *w, n, i.*
Luzula sp. : *m, t, n, w, i, e.*
Mariscus : *e, t.*
Scirpus nodosus : *t, e, m.*
Carex pumila : *e, m, w, i.*
Microlena stipoides : *t, m.*
Deyeuxia Billardieri : *n.*
Dichelachne crinita : *m, e.*
Trisetum subspicatum : *i, w.*
Poa anceps : *m, e, n, w.*
Poa caespitosa : *m, e, w, i.*
Festuca multinodis : *n, i.*
Agropyrum scabrum : *m, e, n, i.*
Asplenium obtusatum : *w, m.*
Asplenium flaccidum : *m, i.*
Aspidium Richardi : *i.*
Polypodium serpens : *m, w, i.*
Polypodium Billardieri : *w.*

Thus in this list, although every plant is adapted by texture of leaf, succulence, hairiness, leatheriness, glaucescence, or spinescence, or a combination of these characters, to withstand drought, the individual species may often be found far from the sea on mountain tops or rock faces on the hills, by fresh water lakes, or in any situation where the light-demanding nature of the plants can be satisfied. While, therefore, the physiognomy of the coastal vegetation is recognizable as such, it is only by such plants as the sea celery (noted by Captain Cook as "sellery"), *Apium prostratum, Carex pumila, Colobanthus Muelleri, Hymenanthera crassifolia, Mesembryanthemum australe, Rhagodia nutans,* New Zealand spinach (*Tetragonia trigyna*), *Spergularia media, Sonchus asper* (var. *littoralis*), and *Salicornia* that the observer can be certain that he is dealing with a sea-marginal vegetation. Of all these plants *Salicornia* is the one most restricted to a salty situation, and if the salt is removed it is soon smothered by quicker-growing vegetation. Species of this genus occur in many parts of the world, have the same faculty for enduring salt, and are as reliable indicators of its presence as the New Zealand species.



TYPICAL PLANT COVERING ON TOKOMAPUNA, AN OUTLYING ISLAND OF KAPITI.

Action of Wind-borne Sea Salt.

There is no doubt that where large quantities of salt are carried ashore in the sea winds a solvent action on the soil phosphates is exercised so that these are leached down into the subsoil, where under certain conditions they are deposited as a hard-pan with the iron and other elements which form these pans in the subsoil. Both at the Bluff, Southland, and at Campbell Island samples of pans have been analysed showing over 1 per cent. of phosphoric acid (see 1909 Annual Report of Agriculture Department, p. 470, Chemistry Section).

Ohau Bay, next to Te Kaminaru Bay, is a narrow valley running north and south on the Makara side of the Wellington Peninsula. The bay, therefore, faces the track of the strong north and north-westerly gales off the Tasman Sea which must carry large quantities of salt ashore as spray. The valley behind the bay is shut in by high hills, but the valley floor is smooth and rises very gradually for about a mile, being under pasture. There is therefore here an opportunity for examining the effect of salt on soil and subsoil. Samples were drawn at the bay immediately behind the boulder beach and at every quarter mile inland, with the results given in Nos. K/3025–3032 of the accompanying table of analyses. The leading features disclosed by these analyses are the influence of salt in leaching phosphates from the soil to the subsoil, the accumulation of magnesia, the high availability of the phosphate left in the topsoil, and the great increase in the potash content. It will be noticed that only the area sampled nearest the sea shows any abnormality in the available phosphoric

Chemical Analyses of Sea Littoral Soils.

Results, except *, are percentages on soil dried at 100° C.

Laboratory No.	Locality.	Volatile Matter.			Total Nitrogen.	1-per-cent. Citric-acid Extract, Dyer's Method, Hall's Modification. ("Available Plant-food.")				Hydrochloric-acid Extract. ("Total Plant-food.")				Lime-requirement, %$CaCO_3$.		Other Details.
		* On Air-drying.	* At 100° C.	On Ignition.		Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5.	Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5.	On Air-dried Soil.	On Soil dried at 100° C.	
K/2262	Bluff, Southland, virgin tussock land	..	5·02	..	0·78	0·16	0·15	0·030	0·035	0·56	0·33	0·16	0·27	..	..	..
K/2263	Bluff, Southland, subsoil of K/2262	..	3·74	..	0·18	0·18	0·14	0·017	0·023	0·67	0·37	0·14	0·19	..	..	..
K/2621	Centre Island, Foveaux Strait	..	12·00	..	0·63	0·07	0·05	0·014	0·060	0·33	0·20	0·10	0·31	..	..	..
K/2658	Bluff, Tiwai Point	..	7·06	..	1·26	0·50	0·23	0·030	0·030	1·12	0·54	0·07	0·23	..	..	..
K/2659	Bluff	..	8·28	..	1·24	2·09	0·15	0·030	0·200	4·52	0·49	0·13	0·66	..	..	..
K/2768	Bluff Hill, below reservoir	..	3·30	..	0·21	0·07	0·03	0·010	0·010	0·22	0·13	0·09	0·07	..	..	..
K/2769	Bluff Hill, subsoil of K/2768	..	2·38	..	0·11	0·07	0·03	0·010	0·010	0·26	0·16	0·08	0·07	..	..	..
K/2622	Puysegur Point, Fiord County	..	2·60	..	0·16	0·00	0·06	0·010	0·020	0·20	0·20	0·08	0·09	..	..	..
K/2623	Resolution Island, Fiord County	..	46·60	..	2·20	0·56	0·26	0·015	0·020	1·50	0·19	0·05	0·20	..	..	..
K/2624	Resolution Island, subsoil of K/2623	..	13·50	..	1·82	0·18	0·11	0·010	0·010	0·50	0·11	0·03	0·12	..	..	..
K/2626	Supper Cove, Fiord County	..	5·54	..	0·28	0·24	0·10	0·040	0·020	0·64	0·84	0·12	0·13	..	..	..
K/2627	Snug Cove, Fiord County	..	8·92	..	1·00	0·08	0·06	0·030	0·020	0·48	0·29	0·07	0·09	..	..	..
K/2628	Caswell Sound, Fiord County	..	11·66	..	1·60	1·50	0·18	0·030	0·040	4·72	0·16	0·13	0·13	..	..	..
K/2629	Anita Bay, Milford Sound	..	14·64	..	0·92	0·17	0·47	0·030	0·040	0·56	2·55	0·05	0·09	..	..	..
K/2631	Milford Sound	..	6·48	..	0·15	0·06	0·03	0·010	0·040	0·57	0·67	0·06	0·15	..	..	..
K/2632	Milford Sound	..	3·04	..	0·31	0·05	0·04	0·010	0·030	0·28	0·47	0·04	0·10	..	..	..
K/2633	Milford Sound, subsoil of K/2632	..	1·80	..	0·10	0·04	0·02	0·005	0·090	0·33	0·56	0·06	0·19	..	..	..
K/2634	Milford Sound, Sandfly Point	..	4·88	..	0·22	0·04	0·04	0·010	0·050	0·22	0·62	0·06	0·21	..	..	..
K/2635	Milford Sound, subsoil of K/2634	..	1·49	..	0·17	0·05	0·04	0·010	0·020	0·26	0·72	0·06	0·18	..	..	..
K/2636	Bowen Falls, Milford Sound	..	3·47	..	0·07	0·15	0·05	0·010	0·110	0·36	0·60	0·09	0·26	..	..	..
K/2637	Cone Island (primitive)	..	12·98	..	2·25	0·07	0·07	0·010	0·130	0·20	0·20	0·15	0·76	..	..	..
K/2638	Cone Island (primitive)	..	16·06	..	1·70	0·09	0·07	0·010	0·130	0·26	0·25	0·18	0·58	..	..	..
K/2639	Cone Island (primitive)	..	6·61	..	0·91	0·01	0·05	0·010	0·250	0·21	0·16	0·14	0·79	..	..	..
K/2640	Cone Island (primitive)	..	2·44	..	0·20	0·03	0·03	0·010	0·360	0·32	0·29	0·17	1·09	..	..	..
A/1183	Topsoil, Chatham Islands	..	..	96·87	..	..	..	..	..	0·78	0·76	0·07	0·005	..	..	Samples A/1183–84 ashed prior to extraction.
A/1184	2nd grade topsoil, Chatham Islands	..	5·34	88·28	..	..	..	..	..	0·44	0·46	0·04	0·003	..	..	Humus soil.
A/1185	Subsoil, Chatham Islands	..	0·18	1·24	0·039	..	..	..	..	0·16	0·17	0·02	Nil	..	..	Coarse sand.
B/873	Great Mercury Island	19·2	2·20	14·90	0·338	0·098	0·123	0·021	0·002	0·34	0·64	0·11	0·05	0·34	0·35	p. H, 5/6.
B/874	Great Mercury Island	17·2	3·00	14·40	0·403	0·129	0·131	0·025	0·002	0·40	0·54	0·12	0·04	0·24	0·25	p. H, 5/8.
B/875	Great Mercury Island	21·1	3·00	16·50	0·330	0·171	0·190	0·024	Trace	0·51	0·92	0·09	0·05	0·25	0·26	p. H, 6–0.
G/499	Turanganui, Palliser Bay	..	14·47	7·45	0·184	..	..	0·028	0·006	0·33	0·40	0·37	0·05	..	..	..
G/801	Te Kaminaru Bay	2·0	2·38	6·75	0·224	..	..	0·037	0·039	0·42	0·46	0·33	0·10	..	..	..
K/3025	Ohau Bay, Terawhiti	..	5·88	9·94	0·448	0·09	0·070	0·030	0·010	0·48	0·62	0·34	0·17	..	..	Farthest from sea.
K/3026	Ohau Bay, subsoil of K/3025	..	2·76	4·60	0·140	0·05	0·030	0·010	0·010	0·46	0·54	0·28	0·08	..	..	..
K/3027	Ohau Bay	..	1·56	5·80	0·280	0·04	0·030	0·010	0·010	0·52	0·18	0·05	0·04	..	..	Nearest to K/3025.
K/3028	Ohau Bay, subsoil of K/3027	..	1·60	2·34	0·216	0·03	0·020	0·010	0·010	0·42	0·22	0·08	0·04	..	..	..

Chemical Analyses of Sea Littoral Soils—*continued.*

Results, except *, are percentages on soil dried at 100° C.

Laboratory No.	Locality.	Volatile Matter.			Total Nitrogen.	1-per-cent. Citric-acid Extract, Dyer's Method, Hall's Modification. ("Available Plant-food.")				Hydrochloric-acid Extract. ("Total Plant-food.")				Lime-requirement, % $CaCO_3$.		Other Details.
		* On Air-drying.	* At 100° C.	On Ignition.		Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5.	Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5.	On Air-dried Soil.	On Soil dried at 100° C.	
K/3029	Ohau Bay	..	1·86	5·36	0·168	0·03	0·030	0·010	0·010	0·42	0·08	0·08	0·04	..	..	Nearest to K/3031.
K/3030	Ohau Bay, subsoil of K/3029	..	1·26	4·14	0·140	0·04	0·020	0·010	0·010	0·30	0·10	0·07	0·03	..	..	..
K/3031	Ohau Bay	..	2·84	8·00	0·182	0·04	0·020	0·010	0·030	0·44	0·18	0·09	0·14	..	..	Nearest to sea.
K/3032	Ohau Bay, subsoil of K/3031	..	3·44	6·88	0·214	0·03	0·030	0·010	0·070	0·34	0·14	0·08	0·21	..	..	..
K/11–14	Titahi Bay, hill soils, mean of 4	..	3·89	6·84	0·247	..	..	0·017	0·008	..	..	..	..	..	..	..
J/1054	Titahi Bay, swamp soil	..	6·20	12·65	0·388	..	..	0·018	0·118	..	..	..	..	..	..	..
J/1055	Titahi Bay, swamp soil	..	22·30	33·44	1·144	..	..	0·017	0·045	..	..	..	..	..	..	..
J/892	Titahi Bay, salt meadow (primitive)	..	1·86	5·89	0·171	..	..	0·030	0·024	..	..	..	..	..	..	0·24 % NaCl.
J/638	Titahi Bay, Cervantes Point	..	2·00	4·75	0·186	..	..	0·008	0·049	..	..	..	..	..	..	Alkaline, sandy.
J/639	Titahi Bay,	..	8·26	8·80	0·373	..	..	0·007	0·039	..	..	..	..	..	..	..
J/26	Titahi Bay, hill soil	..	3·00	8·06	0·375	..	..	0·024	0·061	..	..	..	..	..	..	..
G/29	Somes Island, four paddocks near buildings	..	3·63	8·86	0·242	..	..	0·017	0·010	0·33	0·43	0·41	0·10	..	..	Cl = NaCl, 0·012.
G/30	Somes Island, poor paddock at top of hill	..	4·47	7·65	0·198	..	..	0·030	0·006	0·26	0·46	0·42	0·06	..	..	Cl = NaCl, 0·015.
G/31	Somes Island, virgin paddock on south face	..	3·22	9·24	0·269	..	..	0·020	0·117	0·24	0·32	0·41	0·31	..	..	Cl = NaCl, 0·030.
G/127	Somes Island, extreme north end	..	23·50	26·03	0·530	..	..	0·013	0·187	Trace	Trace	0·54	0·84	..	..	Cl = NaCl, 0·046.
H/99	Mana Island, cliffs, north end	..	3·35	7·39	0·266	..	..	0·034	0·007	0·48	0·58	0·53	0·12	..	..	..
H/100	Mana Island, near sea and settlement	..	4·88	11·92	0·392	..	..	0·011	0·165	0·44	0·27	0·22	0·43	..	..	..
G/470	Kapiti Island, north end of spur	..	12·07	6·13	0·148	..	..	0·037	0·083	0·54	0·48	0·42	0·17	..	..	..
G/471	Kapiti Island, Webber's paddock	..	7·19	6·63	0·124	..	..	0·021	0·024	0·93	0·37	0·24	0·09	..	..	..
G/472	Kapiti Island, Rangitira Point, swamp clay	..	18·02	14·91	0·551	..	..	0·040	0·027	0·87	0·64	0·65	0·17	..	..	..
G/473	Kapiti Island, Rangitira Point, sandy soil	..	10·06	4·63	0·159	..	..	0·021	0·053	1·03	0·26	0·32	0·12	..	..	..
G/474	Tokomapuna Island	..	18·53	25·36	1·041	..	..	0·056	0·439	1·67	0·66	0·57	0·66	..	..	..
G/476	Motukarara	..	5·65	3·51	0·139	..	..	0·014	0·081	0·59	0·22	0·10	0·14	..	..	..
G/477	Tahoramaurea Island, or Brown's Island	..	18·08	12·36	0·436	..	..	0·047	0·346	0·31	0·22	0·41	0·62	..	..	..
J/21	Bluff, Southland	..	4·16	13·87	0·431	..	..	0·010	0·045	..	..	..	..	..	..	..
J/23	Brighton Bluff, Otago	..	8·16	21·78	0·793	..	..	0·030	0·026	..	..	..	..	..	..	..
E/976–1	Rangitikei dunes, Wellington	..	0·08	0·35	..	..	..	0·014	0·031	1·58	0·54	0·15	0·06	..	..	..
–2	Rangitikei dunes, Wellington	..	0·14	0·44	..	..	..	0·012	0·031	1·52	0·49	0·19	0·06	..	..	..
E/1027	Sand from Waikato Heads	..	0·20	0·33	..	..	..	0·013	0·012	1·99	0·74	0·09	0·05	..	..	..

acid content, and this is where the greatest effect from salt would be felt. In the subsoils there is strong evidence of an iron pan forming in the case of K/3028 and K/3030. In K/3032 the subsoil was deeper, and the sampler did not apparently reach the area of deposition.

That salt is a great solvent of rock material is indicated by the following analyses, showing the original rock and the redeposited wall of an example of honeycomb weathering in greywacke from Fitzroy Bay, Wellington :—

	Deposited Portion. Per Cent.	Unweathered Rock. Per Cent.
Silica	69·10	74·01
Alumina	11·98	13·95
Ferric oxide	9·57	3·70
Lime	0·80	0·20
Magnesia	0·46	..
Soda	2·90	2·85
Potash	2·00	1·71
Loss on ignition	2·70	3·10

The high phosphate and calcium content of most maritime soils in New Zealand may be safely attributed to the remains of pre-existent life, but the high potash content is probably due to the action of sea-water in depositing potash salts, also in liberating potash from the inert soil silicates, the sodium salts being more largely lost by leaching than the potash salts.

All the islands near Wellington show high phosphate content where soil-samples are taken in places favourable to the congregation of bird, animal, or human life in the past. Where taken in situations unfavourable, as on the top of high flat islands, the figures are normal, except for magnesia and potash, which are contributed from the sea. This applies, for example, to high pasture land on Mana Island. The shrubbery on a small island off Kapiti is tenanted nightly by thousands of starlings, showing that enrichment by phosphates is still proceeding, as demonstrated by inspection and analysis of the roosting-grounds.

Chemical Characters of Some Littoral Soils.

In connection with recent schemes to reclaim estuarial waste lands, three areas have been examined and a series of the soils analysed from widely separated localities, Lake Ellesmere in Canterbury, Blueskin Bay in Otago, and the Napier lagoon and lands elevated by the 1931 earthquake. All three series show the chemical characters claimed for sea littoral soils at their best—the high amount of mineral plant-food in available condition, particularly phosphoric acid and potash, with the lime and magnesia also present in large amounts. The available phosphoric acid is always very high compared with the total amount present, as it generally is in maritime soils.

Other analyses of similar soils where the action of sea salt has evidently greatly influenced the composition of the soil are those collected by the writer around the coasts of Otago and Southland. The Bluff coastal soils show remarkably high available phosphoric acid and potash,

but the hill soils give normal amounts. The analyses of fiord and island soils of south-west Otago are the first to be published. The fiord soils were necessarily taken in situations which were available—that is, on the few flats occurring in this precipitous region, where the mountains rise quickly from sea-level up to a height of 7,000 ft. Naturally the animal life of this extensive area has concentrated on these flats and areas of deep soil, resulting in comparatively high available phosphate content. In a few places the presence of magnesian rocks is indicated by the high magnesian content of the soil, even when taken in the forest as at Anita Bay. Milford Sound also shows high available and total magnesia.

Cone Island, one of the Open Bay islands, covered with primitive vegetation of *Muehlenbeckia complexa*, shows high total and available phosphate. The rock of this island is a limestone. The relatively high total and available magnesia content of the soil may be derived from the sea spray. The rich nature of the soil is indicated by the dense growth of pohuehue. These islands must be deluged with sea spray in westerly gales.

The island soils on the eastern side of New Zealand that have been examined show great paucity of phosphates, possibly due to excessive leaching by salt water and deficiency of life to keep up the supply. The Chatham Islands are very peaty, which renders comparisons difficult, and dolomite occurs there, which may account for the high magnesia content of the soils. On Great Mercury Island the excess of magnesia would seem to be derived from the sea salt, and this would support the idea that there has been great leaching of phosphate from this soil where the pasture is extremely poor and the stock suffer from a malnutrition.

(To be continued.)

INSPECTION OF TOWN-SUPPLY DAIRIES.

DEALING with this subject, the 1931–32 annual report of the Director of the Live-stock Division states: "There are now about five thousand dairies registered for supplying milk to our cities, boroughs, and towns throughout the Dominion, and of these 2,189 supply the four largest centres. During the year all these dairies were kept under close supervision, and where any sign of laxity was observed special attention was paid. The sediment tester has again proved its usefulness. In all districts a large number of milk-samples have been subjected to this test, and where it is found that the milk does not come up to standard the premises are visited and instruction given which brings about an improved condition of the article supplied. A considerable number of composite samples of milk were collected from all districts and sent to the Wallaceville Laboratory for the biological test, and it is satisfactory to report that negative results were obtained, with one exception. This sample came from a herd the milk of which was not being used for city supply. The herd has since been subjected to the tuberculin test and all reacting cows have been eliminated. It is worthy of note that year by year dairymen are becoming more desirous of supplying a better article, and just lately we have had a number of inquiries with regard to supplying milk from certified herds free from tuberculosis. Rules have been drawn up so that dairymen may be able to sell milk under these conditions."

COMMERCIAL FERTILIZERS AND THEIR BASIS OF SALE.

VI. POTASH SALTS.

J. A. BRUCE, Inspector of Fertilizers, Department of Agriculture, Wellington.

THE principal sources of potash are the various water-soluble salines obtained from underground mineral deposits of crude potash. The most notable mines occur in Germany, where an industry of great magnitude, comparable with that of the famous nitrate industry of Chile, has long been established. More recently discovered potash beds of similar character to those of Germany occur in France (Alsace), Spain, Poland, and United States (New Mexico). Russia has easily the largest known resources of potash, but so far they have not been exploited to any great extent.

The generally accepted opinion of geological authorities concerning the formation of the German and French potash beds is that they are the residues of dried up inland seas like the Dead Sea of Palestine. The same opinion would also appear to be held in reference to the other deposits cited. In the deposits of Germany many different types of crude salts and saline minerals of varying composition occur in roughly-defined layers of great thickness. In such layers rock salt, and the potash-bearing compounds carnallite (9 to 17 per cent. potash), kainit (12 to 16 per cent. potash) and sylvinite and hardsalt (16 to 17 per cent. potash) are found in association with salts of magnesia, lime, and other saline materials.

THE POTASH INDUSTRY OF GERMANY.

Potash deposits which have proved of great value to agriculture throughout the world were discovered in the year 1857 while borings were being made for rock salt at Stassfurt near the Harz Mountains. However, the importance of this discovery was not realized until 1860, and the first factory for refining crude potash salts followed in 1861. Further discoveries of extensive deposits were subsequently made, and within recent years mines have been worked in the districts of Hanover, Stassfurt, South Harz, Werra, Mansfeld, Halle, and Unstrut. Taking the districts together, the deposits are so large—estimated at approximately 14,000,000,000 cubic yards—that the whole world could probably be supplied for a thousand years or more at normal rates of production. As affording some idea of the enormous scope of the industry, it may be mentioned that in the year 1922, 55,000 hands were employed, notwithstanding the fact that of a total of 214 shafts only 128 were in operation, while eighty-six were idle. Seventy-six chemical works were engaged in refining the crude salts from these mines, the production of which alone amounted to over 11,000,000 tons. Operations to-day have necessarily been considerably restricted, as like many other industries the potash industry has suffered severely from the economic depression.

The potash-producers of Germany are organized into a powerful sales organization or syndicate (Kalisyndicat) with headquarters at Berlin.

This group has enormous investments of capital in the mines and refineries, as well as possessing very efficiently-run propaganda and technical advisory services. Until the outbreak of war in 1914 the Potash Syndicate had, practically speaking, the exclusive control of the sale of potash salts throughout the world. The very serious consequences of agricultural potash shortage had to be faced by many belligerents as a result of the complete shutting-off of German potash supplies.

The Industry in France.

Rich deposits, consisting chiefly of the potash-bearing (saline) material sylvinite, situated in the Haut-Rhin district near the Vosges Mountains in Alsace, are estimated to contain about 300,000,000 tons of chloride of potash. Discovered in 1904, and worked to a limited extent by Germany for several years before the Great War, these deposits became the property of France at the cessation of hostilities in 1918.

Like the German industry, which is controlled officially by a federal council, the French Government exercises some control over the industry in Alsace. A sales agency, however, the Société Commerciale des Potasses d'Alsace, formed in 1919, is responsible for the marketing of the mine products, consisting for the greater part of chloride of potash.

Close co-operation with German producers has been maintained by the French potash-producers in recent years as far as grades marketed and prices, &c., are concerned. Owing to the scarcity of sulphate of potash in the deposits the chemical conversion of muriate of potash into sulphate of potash is not undertaken to any great extent in Alsace by reason of the fairly high production costs entailed. In 1922 seventeen shafts were reported to be working, and in 1924 the production of crude salts from the mines was in excess of 1,000,000 tons.

Potash in Poland.

Deposits of kainit and sylvinite with some carnallite occur near the salt mines of Carpathia, in Galicia, in the Kalusz, Stebnik, Drobhoycz, and Stanislawow districts. The Stebnik kainit, sold in three grades, contains about 9 or 10 per cent. of actual potash present in both sulphate and chloride form. The kainit from the Kalusz Mine is sold in several grades varying in actual potash content from 12 to 17 per cent. The Polish potash manure salts contain 20 to 22 and 30 to 32 per cent. actual potash respectively. Production of crude salts was about 80,000 tons in 1924.

Potash Importations into New Zealand.

Practically all potassic salts absorbed by agriculture in New Zealand are brought from Germany and France, with the exception of a few small shipments of kainit and 30-per-cent. grade salt which have arrived here recently from Poland and Belgium. The little that has come from Belgium is apparently mined elsewhere in Europe, as no known Belgian deposits are exploited.

Importation statistics covering the past twenty years indicate that, while our consumption has been and still is very small when compared with our high consumption of phosphates, the use of potash has more than doubled during the last eight years (April, 1924 – March, 1932)

when compared with the preceding eight *normal* years (April, 1911 – March, 1915, and April, 1920 – March, 1924). The period affected by the Great War is not taken into account, as only some 225 tons of potash fertilizers were imported during those abnormal years. Until 1925 kainit was the principal form of potash carrier imported, but since that year it has steadily given place to the higher grade 30-per-cent. potash salt of over double the fertilizing strength. Taken together, kainit and potash manure salt (chiefly 30-per-cent. K_2O grade) represent roughly 80 per cent. of the total potash fertilizer imports of nearly 95,000 tons for the past twenty-year period ended in March of this year. Muriate and sulphate of potash (mainly the sulphate), the importations of which have remained proportionately steady throughout, account for the remaining 20 per cent. During the past three years ending 31st March in each case the import figures for all forms of potash are: 1929–30, 8,190 tons; 1930–31, 8,190 tons; 1931–32, 4,628 tons.

Some Points regarding the various Grades and Forms of Potash.

The following types of potash salts are marketed in this Dominion:—

(1) Potash manure salt	..	30 per cent. "actual potash" as chloride.
(2) Sulphate of potash	..	48 per cent. "actual potash" as sulphate.
(3) Kainit ..	..	14 per cent. "actual potash" as chloride.
(4) Muriate or chloride of potash ..	..	50 per cent. "actual potash" as chloride.
(5) Potash manure salt	..	20 per cent. "actual potash" as chloride.

The finely crystalline potash salts on the market from Germany somewhat resemble common salt in appearance, although the colour of different shipments, more particularly those from France, varies owing to the presence of traces of harmless impurities such as iron, clay, and organic matter. In some cases the crude or lower-grade potash carriers, such as kainit, are put on to the market direct without any special treatment other than perhaps grinding; but, as a rule, they are partially refined as far as economically possible, so as to avoid the cost of transport and handling of less desirable or unwanted material with which the potash is associated in the mines.

Potash fertilizer salts are sold under a wider range of qualities overseas, but only those that are used in New Zealand will be referred to. The principal potash-bearing crude salt is carnallite, which contains only 9 to 17 per cent. of actual potash (K_2O). After being taken out from the mines this is purified by a process of recrystallization to obtain muriate of potash; and the potash salt known to us in 20 and 30 per cent. grades may be obtained as a by-product, although it also occurs naturally to some extent. Sulphate of potash is made from the muriate by treatment with kieserite (sulphate of magnesia) or with sulphuric acid. Kainit and hardsalt (sylvinite) are the crude salts as mined.

Potash Manure Salt, 30 per cent. and 20 per cent.

The 30-per-cent. grade salt, being cheaper per unit of potash than other forms of potash on the market with the exception of the muriate (50-per-cent. grade), is the main type of potash fertilizer employed in this country. The name "potash manure salt" is unfortunately not an appropriate one for distinguishing this salt from the various other

potash fertilizers, such as muriate and sulphate of potash, which are also designated chemically as potash salts or potash manure salts.

It has already been stated that both grades are either partially refined crude salts from the mines or are a by-product in the manufacture of the muriate of potash. Besides containing chloride of potash they carry impurities in the form of common salt and small proportions of sulphate or chloride of magnesia and calcium salts. (See Table 4 for detailed percentage composition.)

Since the 30-per-cent. salt has 30 per cent. of plant-food or actual potash (K_2O) in its composition, it cannot be termed a low-grade fertilizer; on the other hand, it is not nearly so concentrated as the sulphate and muriate of potash, both of which have somewhere about 48 to 50 per cent. of actual potash in their composition. Very little, if any, of the 20-per-cent. salt now appears to be sold in the Dominion, but the principal use of the 30-per-cent. quality is for pasture top-dressing, while the great majority of proprietary mixed fertilizers for special crops also contain minor proportions of this 30-per-cent. salt.

SULPHATE OF POTASH.

As a fertilizer sulphate of potash is customarily sold on a basis of 48 or 48·6 per cent. of actual potash (K_2O), equivalent to about 90 per cent. sulphate of potash, thus showing a fairly high degree of purity. Its high plant-food content entitles it to be rated as a concentrated fertilizer, practically on a par with urea (46 per cent. of nitrogen).

Sulphate of potash occurs naturally to a minor extent in the French and German deposits, but in practice it is made (chiefly in Germany) by treating the muriate with sulphate of magnesia or with sulphuric acid. It is marketed in good mechanical condition as a light-grey or faint-pink salt, at a somewhat higher price than the muriate owing to the greater cost of production. Preference is given to it for potato, tobacco, and some market-garden crops in which there is any risk of quality being adversely affected by dressings of the chloride forms of potash. Certain limited amounts are used in the preparation of proprietary mixed fertilizers, but not to the same degree as is the 30-per-cent. grade potash manure salt.

MURIATE OR CHLORIDE OF POTASH.

This is the potash equivalent of common salt (chloride of sodium) and has a similar taste. It is manufactured by dissolving the ground crude salt (carnallite) in vats of boiling magnesium chloride, which is then concentrated and allowed to stand for several days to crystallize.

Although available in more than one grade on British and Continental markets, the commercial chloride, or muriate as it is more popularly termed, is customarily sold here on a basis of 50 per cent. actual potash (K_2O). Although having a high concentration of potash (K_2O) it is not quite so pure (purity 80 per cent. chloride of potash) as the sulphate, but actually it contains slightly more potash (K_2O), and is much cheaper per unit than the sulphate. Its impurities consist largely of common salt present to the extent of 14 or 15 per cent. Sulphate of potash is from 90 to 95 per cent. pure,

being almost free from impurities such as common salt. The local small importations of muriate mostly go to fruitgrowers. Muriate is suitable for the majority of crops requiring potash with the exception of potatoes, tobacco, and one or two others for which the sulphate or carbonate form of potash is preferred. Considerable savings in transport and haulage can be effected by its use, as it is at present cheaper per unit of potash than other forms of potash offered.

KAINIT.

Kainit is technically a mineral compound of chloride (muriate) of potash and sulphate of magnesia. As found in nature the commercial product marketed as fertilizer varies widely in composition according to the mine from which it is derived—that is to say, German, French, or Polish, &c. It occurs in irregular deposits, occasionally as a white but more often as a reddish salt. It contains a considerable amount of rock salt (sodium chloride). (See Table 4 for composition.) The kainit now on the overseas markets differs from what was originally sold as kainit. The modern product is stated to be a mixture of carnallite, sylvinite, and/or hardsalt ground with rock salt, the content of actual potash varying from about 12 to 16 per cent.

On the Continent of Europe kainit, by reason of its high percentage of common salt, is employed for killing weeds, such as charlock, in cereal crops. Kainit is well recognized by farmers in New Zealand as being specially suited for crops requiring a certain amount of common salt, such as mangels, &c.; nevertheless it is the most expensive of all the potash fertilizers per unit of potash, and seeing that the 30-per-cent. salt is much cheaper and contains a sufficiency of common salt, a saving could be effected by always using the latter in place of 12 to 14 per cent. kainit, which, after all, is nothing more than a low-grade potash salt for which a comparatively high price is paid.

Confusion in Use of Word "Potash."

Confusion almost invariably arises out of the use of the word "potash." The average purchaser does not make any distinction between the various qualities of potash—whether they are in the form of sulphate of potash, or muriate of potash, or 20-per-cent. or 30-per-cent. potash manure salts. It is only natural to expect that he is somewhat perplexed when it is found from the invoice certificate he receives that sulphate of potash, for instance, described in the price-list or quoted by a salesman as a 90-per-cent. grade, contains actually only 48 per cent. of potash.

The correct way to describe the quality of a potash fertilizer is to state the percentage of dipotassic oxide or K_2O and the form in which it occurs—as sulphate or as chloride. Although only a hypothetical compound so far as fertilizers are concerned, oxide of potassium has been universally adopted as the standard method of description of the essential potash plant-food contained in any fertilizer. Therefore every potash salt, whether it be of a purity of 90 per cent., 80 per cent., or even 100 per cent., must have its potash content stated in statutory statements in terms of the oxide of potassium (K_2O), or "actual potash" as it is frequently termed. This "actual potash" content, which is in the first place determined or checked by a chemist or analyst, should be the guiding factor as regards quality. Purity figures can be ascertained by a simple arithmetical conversion of "actual potash" to sulphate or muriate of potash as the case may be. Similarly, if

the quality of a potash fertilizer or of a mixed fertilizer containing some potash is expressed in an advertised statement in terms of either sulphate or muriate of potash equivalency instead of in "actual potash" (K_2O) a simple conversion may be made. The following table will be found helpful in cases of this sort :—

Table 1.—Equivalents of Potash (K_2O) in Terms of Sulphate of Potash and Muriate (Chloride) of Potash.

Potash (K_2O).	Sulphate of Potash.	Chloride of Potash.	Potash (K_2O).	Sulphate of Potash.	Chloride of Potash.	Potash (K_2O).	Sulphate of Potash.	Chloride of Potash.	Potash (K_2O).	Sulphate of Potash.	Chloride of Potash.
Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	1.85	1.58	6	11.1	9.5	12	22.2	19.0	30	55.5	47.5
2	3.7	3.2	7	12.9	11.0	14	25.9	22.2	48	88.8	76.0
3	5.5	4.7	8	14.8	12.7	20	37.0	31.7	49	90.6	77.6
4	7.4	6.3	9	16.6	14.2	21	38.8	33.2	50	92.5	79.1
5	9.2	7.9	10	18.5	15.8	22	40.7	34.8	51	94.3	80.7

NOTE.—To convert potash (K_2O) into its equivalent of sulphate of potash multiply by 1·850 ; conversely, sulphate of potash in terms of potash (K_2O) may be ascertained by dividing by 1·850.

To convert potash (K_2O) into its equivalent of chloride of potash, multiply by 1·583 ; conversely, chloride of potash in terms of potash (K_2O) may be found by dividing by 1·583.

VALUATION OF POTASH FERTILIZERS.

In comparing potash fertilizers "unit values" are often a useful basis for arriving at a decision of what is the best value. If, for example, a potash salt priced at £9 17s. 6d. per ton is guaranteed to contain 30 per cent. of "actual potash" (K_2O) soluble in water, it contains 30 units of potash which together cost £9 17s. 6d. The cost of each unit is therefore £9 17s. 6d. ÷ 30 = 6s. 7d. On the other hand, if a potash salt—*e.g.*, muriate—containing 50 per cent. (or units) of actual potash is quoted at 6s. 7d. per unit, the cost per ton is 50 × 6s. 7d. = £16 9s. 2d. (approximately £16 10s.). If then the latter is quoted or calculated at less than 6s. 7d. per unit it is cheaper than the former on its actual plant-food content.

A comparison of potash unit values indicative of the price trend over a period of years is afforded from the table following. It will be noted that the 30-per-cent. potash salt and muriate of potash are now tending toward their pre-war price-level notwithstanding the exchange rate premium.

Table 2.—Potash Unit Values, 1909, 1918, 1924, 1932.

Designation (and Potash Content per Cent.).	Unit Values.*			
	1909.	1918.	1924.	1932.
	s. d.	s. d.	s. d.	s. d.
Sulphate of potash (48) ..	6 0	22 6	8 4	8 1
Muriate of potash (50)	6 0	..	7 0	6 0†
30-per-cent. potash salts (30) ..	6 0	..	7 0	6 7
20-per-cent. potash salts (20) ..	..	..	8 6	..
Kainit (14)	7 6	24 0	10 0	10 6

* Based on recent net prices at Auckland and New Plymouth, except where otherwise stated.
† Free on rail, Auckland.

Fertilizing Value.—The relative quantities of each fertilizer required for per-acre applications in the field is also dependent chiefly on the percentage of actual potash (K_2O) each contains, except where one particular form (that is, chloride or sulphate) is desired for special cropping conditions. By reading the following columns downwards the amount in pounds of any one fertilizer equal to 1 cwt. (112 lb.) of any other potash fertilizer can be seen. For practical purposes sulphate and muriate of potash may be regarded as containing almost the same amount of potash (K_2O).

Table 3.—Fertilizing Value Equivalents.

Fertilizer and Percentage of Potash.	Kainit (14).	Potash Salts (20).	Potash Salts (30).	Muriate and Sulphate of Potash (say, 50).
	lb.	lb.	lb.	lb.
Kainit (14)	112	160	240	400
Potash salts (20)	78	112	168	280
Potash salts (30)	52	75	112	187
Muriate and sulphate of potash (say, 50)	32	45	67	112

To handle 1 ton of muriate (chloride) of potash distributed over, say, 10 acres at 2 cwt. per acre, would cost about the same as the handling of 1 ton of kainit, which, at the same rate of actual potash application, would cover only 3 acres.

Composition of Potash Salts.

Some knowledge of the composition of potash fertilizer salts is always of use to those handling fertilizers. In certain grades there is a proportion of common salt and other substances present which, although classified as impurities of no fertilizing value, may be of special benefit, of no use, or even detrimental to the quality or growth of particular crops. This applies more particularly in the case of the constituent common salt. About 50 to 60 per cent. of common salt is contained in 14-per-cent. kainit; in 20-per-cent. potash salt 40 to 50 per cent.; in 30-per-cent. potash salt 20 to 30 per cent.; and in muriate of potash 15 per cent. or less. (Table 4 gives the average detailed composition of potash salts consumed in New Zealand.)

Table 4.—Average Composition of Potash Salts.

Designation.	Sulphate of Potash.	Chloride of Potash.	Sulphate of Magnesia.	Chloride of Magnesia.	Chloride of Soda (Common Salt).	Sulphate of Lime (Gypsum).	Matter insoluble in Water.	Water.	Guaranteed Minimum of Pure Potash (K_2O).
Sulphate of potash	90·6	1·6	2·7	1·0	1·2	0·4	0·3	2·2	48·6
Muriate (chloride of potash)	..	83·5	0·4	0·3	14·5	..	0·2	1·1	50·4
30-per-cent. potash manure salt	..	48·6	10·2	4·2	26·2	2·2	3·5	5·1	30·0
20-per-cent. potash manure salt	..	33·3	12·0	4·2	40·2	2·1	4·0	4·2	20·0
Kainit (14 per cent.)	..	23·7	..	0·1	62·3	2·5	10·2	1·1	14·0

Sir E. J. Russell, in his bulletin, "Artificial Fertilizers in Modern Agriculture," written for the English Ministry of Agriculture, points out that if the various potash salts differed merely in their content of potassium the choosing between them would be relatively simple. The matter, however, he states, is more complicated; the sodium, magnesium, chloride, and probably sulphate ions all have specific actions on the crop, in addition to those provided by the potassium. In discussing each element separately, attention is drawn, *inter alia*, to the following points regarding each element:—

Sodium: The effect of sodium is twofold; it acts on the soil, making the reserves of potassium more easily available to the crop, and it enables the plant in some way to make better use of a limited ration of potassium. It is an economical fertilizer for mangels and hay; on the other hand, it may damage the quality of potatoes, and hence should not be used for them.

Magnesium: This is an essential constituent of chlorophyll, the green colouring matter of the plant; any deficiency shows itself in a yellowing or "chlorosis" of the leaf, or in premature loss of the leaf. The best known instance is the disease termed "sand drown," a chlorosis affecting tobacco in South California.

Chloride ion: Though not essential to plants, the chloride ion in small amounts appears to be beneficial. Mangels and barley benefit by the use of chloride as a fertilizer, but potatoes do not benefit. In large quantities the chloride ion is harmful to all crops, particularly potatoes, while mangels are more tolerant.

Sulphate: Sulphur is an essential constituent of plants and occurs in some quantity in cabbages, swedes, turnips, and other members of the Brassica family, and it has been shown that sulphates increase the yield of heavy-yielding crops rich in protein. Sulphur appears to be particularly advantageous in dry seasons.

The Amount of Potash in Proprietary Mixed Fertilizers, etc.

The average plant-food content of the unusually large number of New Zealand proprietary factory-mixed fertilizer mixtures carrying the

Table 5.

Fertilizer Designation.	Nitrogen (N) soluble in Water—Per Cent.	Phosphoric Acid (P_2O_5)—Per Cent.	Potash (K_2O) soluble in Water—Per Cent.
Containing Two Plant-foods.			
Potassic superphosphate (local manufacture)	..	16·5*	3·0 (chloride).
	..	19·0*	2·3 (sulphate).
Potassic basic super (local manufacture)	..	17·2†	2·2 (chloride).
Potassic "Phosfull"	..	23·0†	5·0 (chloride).
Potassic "Gafsa"	..	18·0†	8·0 (chloride).
Potassic phosphate (local manufacture)	..	27·5†	5·0 (chloride).
Containing Three Plant-foods.			
Nitrophoska	16·5	16·5*	20·0 (chloride).
Peruvian guano (and potash) ..	5·7†	11·4†	6·0 (sulphate).
Dissolved Peruvian guano	4·5†	9·0‡	1·5 (sulphate).
Nitro-potassic phosphate	3·5†	15·0†	4·5 (chloride).

* Soluble in water. † Insoluble in water. ‡ 6 per cent. soluble, 3 per cent. insoluble in water.

three essential plant-foods is as follows: Nitrogen, 1·3 per cent.; phosphoric acid, 18·5 per cent.; and potash (K_2O), 2 per cent., present principally as potash 30-per-cent. (chloride) salt. The amount of potash may vary, however, from 0·4 per cent. to 7·5 per cent., according to the different manufacturing sources. A dressing of a mixture containing 0·4 per cent. of potash at the rate of 2 cwt. per acre would mean that the crop would receive under 1 lb. of actual potash (K_2O) to the acre. It seems scarcely necessary to emphasize the futility of putting such a small amount of potash in any mixture.

A number of imported and locally manufactured fertilizer mixtures containing two plant-foods and other imported preparations are listed in Table 5 in order to show their potash content in comparison with nitrogen and phosphoric acid.

NOTE.—The attention of those interested is drawn to the following articles in this *Journal*: "Potash and the Great War: Money in Ashes" (B. C. Aston), Vol. 11, p. 18); "Potash in Agriculture (B. C. Aston), Vols. 11, p. 283; 13, p. 446; 14, p. 440; and 16, p. 249); "Potash in New Zealand and other Countries" (P. G. Morgan), Vol. 14, p. 257.

(Series to be continued.)

THE TOMATO STEM BORER (*GNORIMOSCHEMA PLAESIOSEMA* TURNER).

J. MUGGERIDGE, Entomologist, Plant Research Station, Palmerston North.

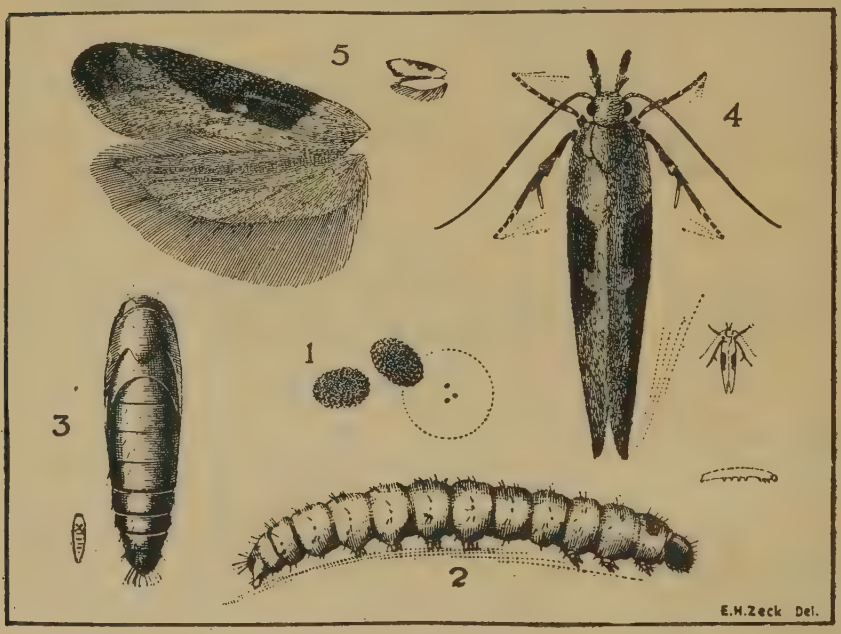
THE purpose of this article is to put on record a history of the tomato stem borer in New Zealand, supplemented with notes from the literature on its life history and control.

During the 1930–31 season there was considerable concern among tomato-growers on account of a new pest which was responsible for the destruction of thousands of tomato plants in different parts of the country. From an examination of infested material the injury was found to be due to a small slightly pinkish-tinged moth larva (Fig. 2) measuring approximately $\frac{7}{16}$ in. in length. Plants suffering from attack gradually wilted and died. On examination, the stems of the wilted and dead plants were found to be severely tunnelled by the small caterpillars referred to.

Specimens of the insects were reared to the adult stage and were identified by the late Mr. Philpott of the Auckland Museum as *Phthorimaea melanoplintha* Meyr., a supposedly native species first described by Meyrick in 1926. The writer also sent specimens to the Bureau of Entomology at Washington, U.S.A., where they were examined by Dr. August Busck. Dr. Busck (1931) reported that these specimens were identical with his *Gnorimoschema (Phthorimaea) tuberosella* Busck, described from Peru, where it is a pest of potatoes. He stated that the species is a native of the west coast of the Americas, and has been received from California reared both from stalks of potato and from its original food plant, *Solanum nigrum* (deadly nightshade). Again, Morgan (1931) refers to the tomato stem caterpillar in New South Wales as a new species described by Turner (1919) as *Phthorimaea plaesiosema*. Dr. Busck has now examined the Australian species and finds it is identical

with *Gnorimoschema melanoplintha* Meyr.* The insect should therefore be known as *Gnorimoschema plaesiosema* Turner.

G. plaesiosema has been present in New Zealand for a number of years and was reared from tomato stems by J. G. Myers in January, 1924. It was only in 1929–30, however, that it began to attract attention here, and in 1930–31 it was a serious pest as already stated. Since this time little has been heard of it, and it is quite likely that the spray treatment recommended in this *Journal* for March, 1931, page 175, has largely contributed to its apparent check or control.



(1) Eggs; (2) larva; (3) pupa; (4) adult moth; (5) fore and hind wings.

[*After Morgan.*

Life History.

In the absence of life-history studies of the pest in New Zealand, the following information from an article by Morgan (see Bibliography) should form a suitable basis for detailed studies when undertaken.

The eggs (Fig. 1) are laid singly on tomato foliage, or in the "eyes" or in the cracks or scars of potato tubers, about three hundred eggs being laid by a single female. The eggs hatch in from seven to eleven days.

The young caterpillars (Fig. 2) may feed upon the leaf surface before commencing to mine into the leaf tissue. From the leaves they make their way into the leaf stalk and work down into the tomato stems,

* For a discussion of the genus see Busck (loc. cit.).

which may be so severely bored as to check the flow of sap and consequently destroy the plant. The length of the larval stage is apparently governed largely by climatic factors, since it may take only three weeks to complete in this stage in the summer but may take up to six weeks in the winter.

The pupae (Fig. 3), which were commonly found in injured tomato stems, are small brownish objects about $\frac{1}{4}$ in. in length. This stage occupies ten to fourteen days.

The adult insect (Fig. 4) is a small greyish-brown moth with a wing expanse of about $\frac{5}{8}$ in. The forewings (Fig. 5) are narrow, with characteristic dark brown patches near the centre. The hind wings are much paler in colour.

Control.

A good and constant cover of lead arsenate spray (1½ lb. powder per 100 gallons of water) thoroughly applied to the whole plant appears to give effective control. Morgan recommended lead arsenate spray applied at a strength of 1½ lb. of the powder to 20 gallons water, or a 50 per cent. lead arsenate dust applied at weekly intervals. All dead tomato plants and such debris should be heaped up and burned. Deadly nightshade (*Solanum nigrum*) should be destroyed likewise. Owing to the fact that the moth readily attacks potatoes, both stalks and tubers, it should be remembered that a potato crop in the vicinity of tomato plants may serve as a source of infestation to the latter.

Bibliography.

Busck, A.: Two New Peruvian Microlepidoptera of Economic Importance (Gelechiidae and Oecophoridae). *Proc. Ent. Soc. Wash.*, Vol. 33, No. 3, March, 1931, p. 59.

Morgan, W. L.: The Tomato Stem Caterpillar (*Phthorimaea plaesiosema* Turner). *Agr. Gaz. N.S.W.*, Vol. 42, p. 919.

Meyrick. Exotic Microlepidoptera, III, 276, 1926.

Turner, A. J. *Proceedings of the Royal Society of Queensland*, Vol. 31, p. 126.

Compensation paid for Stock and Meat condemned.—Compensation to the amount of £13,163 16s. was paid out during the year ended 31st March last for animals condemned in the field for disease under the provisions of the Stock Act, and £10,806 9s. 4d. for carcasses, or parts of carcasses, condemned for disease on examination at the time of slaughter at abattoirs, meat-export slaughterhouses, &c., under the provisions of the Slaughtering and Inspection Act.

Sodium Chlorate for Weed Control.—The annual report of the Live-stock Division for 1931–32 remarks: "During the year sodium chlorate applied by spray has again proved an effective agent in the eradication of ragwort and other soft-leaf weeds. In some localities a measure of success has been obtained with this spray on blackberry, the plants having been sprayed from two to four times with very fair results. In other cases settlers have sprayed once only, at flowering time, to destroy the fruit, this method being quicker than cutting and entailing considerably less labour. So far as mature gorse is concerned, the results of spraying with sodium chlorate have been disappointing, while with broom and lupin the results have been encouraging.

PULPY KIDNEY DISEASE OF LAMBS.

INVESTIGATIONAL WORK IN 1932 SEASON.

D. A. GILL, M.R.C.V.S., D.V.S.M., Assistant Officer in Charge, Wallaceville Veterinary Laboratory.

IN the last article regarding pulpy kidney disease of lambs published in this *Journal*(1) the writer stated the then position so far as research work on the disease in this country was concerned, and mentioned the results obtained by Montgomerie(2), Bennetts(3), and Oxer(4) in their work on identical or very closely allied diseases of sheep and lambs in their respective countries.

It may tend to greater clarity to recapitulate slightly in the first place. In 1930 the writer(5) discovered that a highly potent toxin was present in the small-gut contents of affected lambs, which would set up a condition indistinguishable from pulpy kidney if it was injected into the blood of a normal, healthy lamb. In normal lambs no such toxin was present. There was good reason to suppose that it had been formed in the affected lamb's gut by a microbe.

NOTE.—As the rather frequent use of the terms "toxin" and "antitoxin" is unavoidable, it seems best to digress for a moment in order to make it clear to uninitiated readers what these terms mean. A toxin, for the purposes of this article, simply means a poisonous substance produced by a microbe during its growth. A microbe which has the power to produce a toxin when growing in the tissues or the intestine of an animal can usually be made to produce it also when it is grown artificially in a laboratory, provided it is given the right conditions and food (medium). Different microbes produce different toxins. It is important to note this fact, because it gives the most reliable means we have of telling whether two toxin-producing microbes are of the same species or not. This brings one to the subject of antitoxins. If the toxin produced by a given microbe is inoculated into an animal at intervals, in doses too small to kill it, the animal reacts by forming in its blood and tissues a substance which has the power to neutralize or render harmless the particular toxin that has been injected. This neutralizing substance is called an antitoxin, and it is present in the blood serum of the inoculated animal. It will only neutralize the same sort of toxin as that which was injected, though in some cases it will also have a weak neutralizing effect on toxins produced by microbes of the same group. Thus, if an unknown microbe is found to be a toxin-producer, one can identify it (provided it is not an entirely new variety) by finding out what sort of antitoxin will neutralize its toxin.

Montgomerie(2) confirmed the presence of a powerful toxin in the gut of affected lambs in North Wales. In 1931 the writer isolated several strains of a particular organism from affected lambs in the Oamaru district. There was reason to suppose that this organism was the source of the toxin. At about this time Bennetts(3) published an account of infectious entero-toxæmia of sheep in Western Australia, and a comparison of the organism found by him to be the cause of that disease (*Bacillus ovitoxicus*) with the strains obtained from the Oamaru cases of pulpy kidney suggested that if they were not actually identical they were at any rate very closely allied. (It is a pleasure

to acknowledge at this stage the kindness shown me by Dr. Bennetts in forwarding cultures of *B. ovitoxicus*, together with its toxin and antitoxin, and much helpful information about its cultural peculiarities, &c.) Finally Oxer(4) published a brief account of his work on pulpy kidney in Tasmania, from which he concluded that the cause was the absorption from the small intestine of *B. ovitoxicus* toxin produced there by the growth of that organism.

When the writer published a statement regarding the results obtained in New Zealand(1) it was mentioned that the identity of the New Zealand organism must await tests made with standardized toxins and antitoxins. The following will explain briefly the necessity for this. One organism may look like and grow like another, but may nevertheless produce a different toxin. The strains derived from pulpy kidney cases in New Zealand obviously belonged to a group of closely allied species called the *Bacillus welchii* group. Until a few years ago it was thought that there was only one toxin-producing organism of this sort — namely, *B. welchii*. But in 1928 Dalling(6) described an organism causing lamb dysentery in Britain (L.D. bacillus) which, while it looked like *B. welchii*, produced quite a different toxin. In 1930 McEwen(7), working in the Romney Marsh district in England, described a third species, *B. paludis*, and Bennetts's *B. ovitoxicus* of Western Australia makes a fourth.

Consequently, although as has been previously mentioned in this *Journal*, the New Zealand organism and *B. ovitoxicus* neutralized each other and agreed also in both neutralizing *B. welchii*, it was necessary to make quite sure that they also agreed in their action regarding the other two members of this group. To enable this part of the work to be done the necessary standardized toxins and antitoxins were very kindly sent out from England by Dr. R. A. O'Brien of the Wellcome Physiological Research Laboratories. The toxins and antitoxins of the New Zealand organisms were then carefully tested with results which are shown in Table 1. (In the column headed "Neutralization" "+" means that neutralization occurred, and "—" means that it did not occur.)

Table 1.—Results of Testing Toxins and Antitoxins of New Zealand Organisms.

Toxin.	Antitoxin.	Neutralization.
N.Z. pulpy kidney ..	*B. welchii*	—
	L.D. bacillus	+
	B. paludis	—
	B. ovitoxicus	+
	N.Z. pulpy kidney organism	+

Antitoxin.	Toxin.	Neutralization.
N.Z. pulpy kidney ..	*B. welchii*	+
	L.D. bacillus	—
	B. paludis	—
	B. ovitoxicus	+
	N.Z. pulpy kidney strains ..	+

Considerably more work has been carried out than is summarized in this table, but is not recorded here as it would involve a great deal of detail which might be confusing. It is sufficient to say that the results tabulated agree exactly with those obtained by Bennetts([3]) for *B. ovitoxicus*.

From a comparison of the other characters of *B. ovitoxicus* and the New Zealand strains—their reaction to different culture media, &c.—there appears to be at least one striking difference. When the two organisms are grown on solidified blood serum the New Zealand strains liquefy it in a few days, whereas *B. ovitoxicus* has no such power. Since this is so, and because it is possible that still other distinct species of the *B. welchii* group may be found which may bring to light toxin-antitoxin differences between New Zealand strains and *B. ovitoxicus* (the discovery of the latter revealed a previously unsuspected difference between L.D. bacillus and *B. paludis*) it seems preferable in the meantime to name the New Zealand strains "*Bacillus ovitoxicus* var. *N.Z.*"

Artificial Production of Pulpy Kidney in Lambs.

A small number of very early lambs were used to try the effect of injections of toxins prepared from cultures of the New Zealand strains. Lambs inoculated with this material, either into the blood stream or into the muscles, die in a shorter or longer time (a few minutes to a few hours) depending on the size of the dose injected.

As with lambs which die of this disease under farm conditions, the kidneys are not pulpy at death, but they become so shortly afterwards. The most striking example obtained was one in which the kidney was congested but quite firm and not much altered, even when examined miscroscopically at death, *but within four and a half hours was completely pulpy*. Microphotographs of this case and of the kidneys of some natural cases are here reproduced.

Grounds for Considering that this Organism and its Toxin are Responsible for Pulpy Kidney Disease.

(1) There is a toxin in the small gut of affected lambs which is not present in that of healthy lambs.

(2) If this toxin is inoculated into the blood of healthy lambs they die with symptoms and post-mortem findings that are indistinguishable from a natural case of pulpy kidney.

(3) The toxin in the affected lamb's gut is neutralized if it is mixed with antitoxins prepared from *B. ovitoxicus* (Bennetts), N.Z. pulpy kidney strains, and L.D. bacillus*, but is not neutralized by *B. welchii* or *B. paludis* antitoxin.

* The statement previously made (this *Journal*, April, 1932) that L.D. bacillus antitoxin had not neutralized the toxin in the gut of affected lambs requires explanation. The writer had two different samples of L.D. antitoxin in his possession. It has now been found that whereas one of them (that was used in the experiments previously referred to) was quite unable to neutralize the toxins involved, the other definitely has that power, though not in a very high degree. The reason for this is under consideration at the moment.

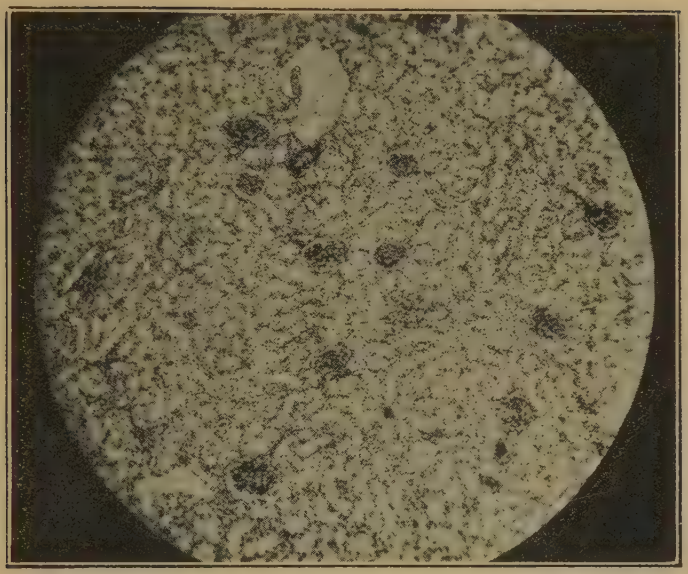


FIG. 1. EXPERIMENTAL CASE OF PULPY KIDNEY: MICROPHOTOGRAPH OF KIDNEY SECTION FROM SPECIMEN COLLECTED AT TIME OF DEATH.

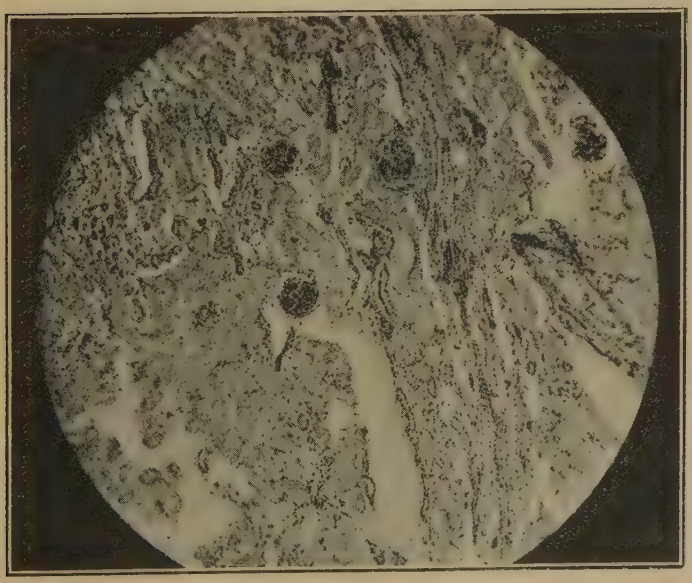


FIG. 2. SAME KIDNEY AS IN FIG. 1, FOUR AND A HALF HOURS AFTER DEATH.

(4) If cultures are made in a suitable manner from the lower small intestine of affected lambs an almost pure growth of this organism results.

(5) Under suitable conditions it can be made to yield a highly potent toxin when it is grown in the laboratory.

(6) This toxin, made in the laboratory, agrees exactly in its toxin-antitoxin relationships with that present in an affected lamb's intestine (see No. 3 above).

(7) The artificially made toxin from this organism, when injected into lambs will cause as marked pulpiness of the kidneys as is ever seen in the naturally occurring disease.

Experiments on the Protection of Lambs against Pulpy Kidney Disease by Use of a Vaccine and Antitoxin made from the Organism involved.

Since this disease usually affects lambs in a given district only during a period of three or four weeks, it will be apparent that if one could give lambs a large inoculation of antitoxin prepared from the organism involved it should protect them from the disease. With this object in view a horse was given repeated and increasing doses of toxin until its blood serum was highly charged with antitoxin. It may be of some interest to give a little general information about this experiment.

Most of the work on the toxin responsible for the disease has been done on mice. It would obviously be too expensive to use large numbers of lambs. So far as could be estimated from the small number of lambs that were used, it took approximately 1,000 times as much toxin to kill a lamb as was needed to kill a mouse. At the time the serum of the horse mentioned above was ready for use it was of such strength in antitoxin that $\frac{1}{10000}$ cubic centimetre was enough to neutralize the amount of toxin that would kill a mouse; in other words, 1 cubic centimetre (about 17 drops) would be enough to protect 10,000 mice against just sufficient toxin to kill them. It follows, then, that since to kill a lamb required 1,000 times as much toxin as would kill one mouse, a cubic centimetre of the horse's serum would be enough to protect a lamb against ten times as much toxin as would be sufficient to kill it. It was decided to inoculate about 1,000 lambs on affected farms, giving each one a dose sufficient to protect it against fifty times the amount of toxin that would be just enough to kill it.

Antitoxin is troublesome to prepare, and if a vaccine were also found to be effective in protecting lambs it would be a more economic procedure to use it than to prepare antitoxin. For this reason, although it was felt from the outset that a vaccine was less likely to be effective, it was decided to try its effect also. (For the information of those who are conversant with the subject it may be mentioned that the vaccine comprised formalin-toxoided whole culture, filtered through paper-pulp to remove coarse particles.) The difference between vaccines and antitoxins, in their effect, is that the antitoxin gives an immediate protection, which is high to start with but gradually fades away, till after a few weeks only traces are left, whereas a vaccine of this sort stimulates the animal's body to produce antitoxin for itself. It takes some days for the body to produce antitoxin in response to an injection of vaccine, and, moreover, the degree to which this is done

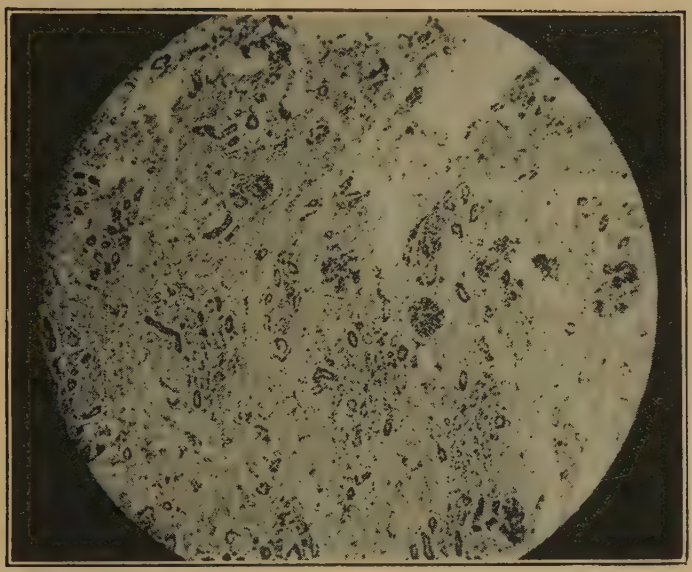


FIG. 3. SAME LAMB AS IN FIGS. 1 AND 2: KIDNEY EIGHTEEN HOURS AFTER DEATH.

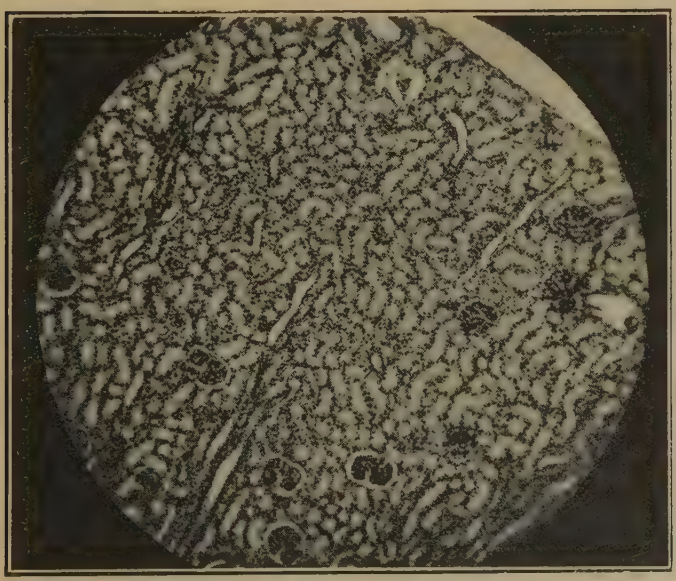


FIG. 4. NATURAL CASE OF PULPY KIDNEY, WITH SMALL-GUT CONTENTS HIGHLY TOXIC: LAMB KILLED AT POINT OF DEATH AND PORTION OF KIDNEY IMMEDIATELY REMOVED.

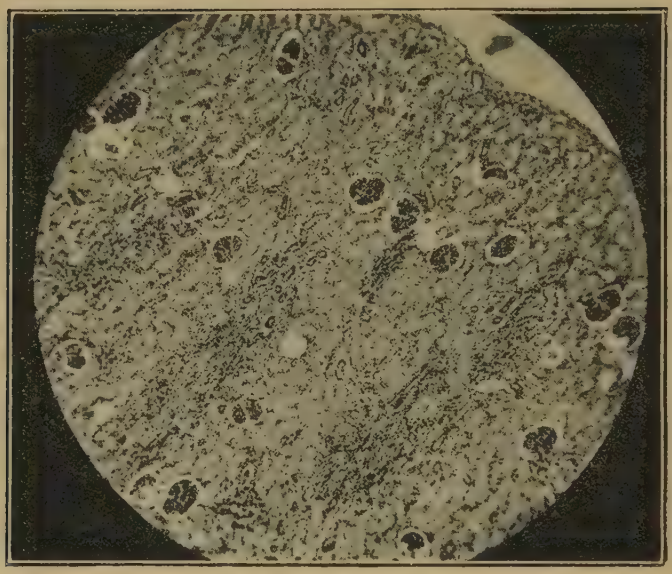


FIG. 5. SIMILAR CASE TO THAT IN FIG. 4, BUT LAMB DEAD TWO HOURS WHEN PORTION OF KIDNEY REMOVED. COMPARE WITH FIG. 2.

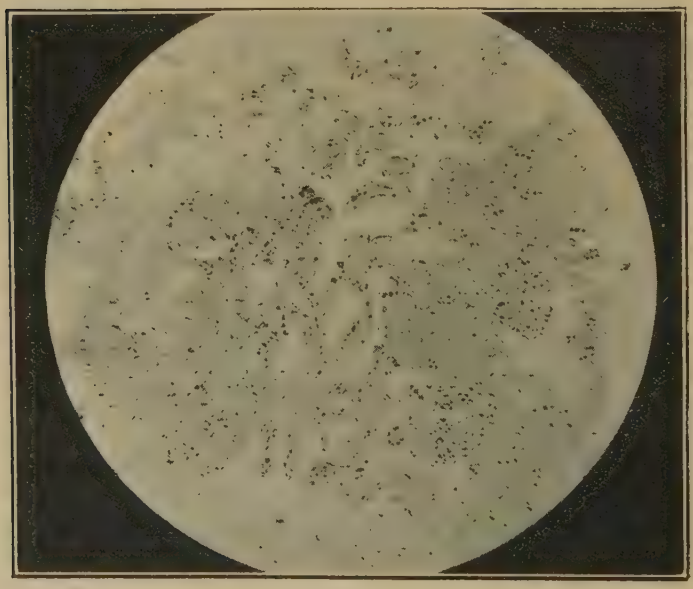


FIG. 6. NATURAL CASE OF PULPY KIDNEY: LAMB DEAD FROM TWELVE TO EIGHTEEN HOURS WHEN SPECIMEN TAKEN. COMPARE WITH FIG. 3.

varies a great deal from one animal to another—some respond well to a single injection, whereas others scarcely respond at all. This will be sufficient to explain why one had little expectation of the vaccine being beneficial, but was decidedly hopeful regarding the use of anti-toxin.

The experiments were carried out in the Ranfurly district of Central Otago, through the generous co-operation of a number of local farmers. Only farms which were known to have had losses annually for some years past were selected, and the farmers themselves chose the particular paddocks in which they had suffered their heaviest losses for the experiments to be carried out in. The ewes had wintered well and came to lambing in excellent condition with plentiful spring feed available, so that it was anticipated that the nutritional factor would come into play and a fairly heavy loss from pulpy kidney be experienced. This did not eventuate, however. The writer was present during the period when deaths are usually most frequent, and during that period there was a good fall of rain at least once a week. The consequence was the the feed was not only plentiful *but was much softer, and longer than usual.* In the writer's opinion this was the principal factor in the low death-rate experienced throughout that period, as the feed was of such a nature that there would be less tendency than usual for digestive disturbances to occur (and give the pulpy kidney organism its opportunity) when the lambs started grazing at two to three weeks of age.

The practice followed was to vaccinate, or inoculate with antitoxin, approximately half the lambs in a given paddock leaving the rest as controls. Vaccination was carried out as far as possible when the lambs were under ten days old, in order to give them time to react to it before they reached the most susceptible age. The antitoxin was used in mobs of lambs where deaths were already occurring, and was often given concurrently with "tailing" operations.

Owing to the few deaths which occurred, either among the experimental lambs or the controls, the results are not very conclusive, but it can definitely be said that, whereas the vaccine had little or no effect, the antitoxin results appear to be very promising indeed. Results with the individual lots of lambs are shown in Tables 2 and 3.

The "doubtful" cases recorded in the tables were almost certainly not due to pulpy kidney, but so that there can be no possible question of bias in recording the results, all deaths occurring after the experiments began and which were not definitely attributable to some other cause have been included. In fairness it may be pointed out that while the

Table 2.—Vaccination Experiments with Lambs.

Owner.	Vaccinated.	Deaths.	Controls.	Deaths.
W.B.	100	0	70	1
L.S. (1)	152	2 (doubtful)	102	3
L.S. (2)	100	3	84	3
L.S. (3)	148	1 (doubtful)	97	0
S.B.	125	2	96	3
J.C.	102	1	100	2
Totals	727	9 (3 doubtful)	549	12

Table 3.—Antitoxin Experiments with Lambs.

Owner.	Antitoxin inoculated.	Deaths.	Controls.	Deaths.
J.D.	155	1 (doubtful)	174	1
E.C. (1)	55	0	69	1
E.C. (2)	100	0	90	0
A.H. (1)	120	1	135	1
A.H. (2)	100	0	82	0
J.K.	125	0	96	0
G.P.	145	1 (doubtful)	215	2 (doubtful)
D.L.	192	0	139	13
W.B.	75	0	72	2
Totals	1,067	3 (2 doubtful)	1,072	20 (1 doubtful)

lambs given antitoxin each received enough to protect against fifty times as much toxin as will kill a lamb, it may be that an occasional lamb will be affected with much more than that amount of toxin. This may explain the single definite pulpy kidney case which occurred among all those given antitoxin. Against this, compare the quite striking result obtained in the case of D.L.'s lambs (Table 3).

Conclusions.

Pulpy kidney disease of lambs is due to the absorption of a powerful bacterial poison, or toxin, from the small intestine. This toxin is produced in the intestine by an organism so closely resembling Bennetts's *B. ovitoxicus* that the writer suggests it be called "*Bacillus ovitoxicus* var. *N.Z.*" This organism can only function in the lamb's small intestine when the conditions therein are suitable for its growth and multiplication. In the writer's opinion the principal factor in rendering the conditions in the lamb's intestine suitable is a digestive disturbance occurring at the time the lamb starts grazing at two to three weeks of age. Field trials of a vaccine and antitoxin with a view to protecting lambs against the toxin produced in their intestine suggest that while the vaccine was of little or no value the antitoxin was definitely effective.

Acknowledgments.

My thanks are due to Mr. C. V. Dayus, M.R.C.V.S., District Superintendent of the Department of Agriculture in Dunedin, for kindly making many of the preliminary arrangements for field experiments mentioned in this article, and for collecting much of the data. Thanks are also extended to the farmers who were good enough to place their lambs at our disposal.

References.

(1) Gill: *N.Z. Journ. Agric.*, Vol. 44, 1932.
(2) Montgomerie: *Veterinary Journal*, Vol. 87, 1931.
(3) Bennetts: Australian C.S.I.R. Bulletin 57, 1932.
(4) Oxer: *Journ. of Aust. C.S.I.R.*, February, 1932.
(5) Gill: *N.Z. Journ. Agric.*, Vol. 42, 1931.
(6) Dalling: Annual Congress British N.V.M.A., 1928.
(7) McEwen: *Journ. Comp.: Path. and Ther.*, Vol. 43, 1930.

Noxious Weed Order.—The Patea County Council has declared tauhinu or New Zealand cotton-wood to be a noxious weed within that county.

TURNIP MANURING EXPERIMENTS IN THE SOUTH ISLAND, SEASON 1931-32.

Fields Division, Department of Agriculture.

THE results of fifty-eight turnip or swede manuring experiments conducted during the seasons 1924–25 to 1930–31 were summarized in the *Journal* for March and April, 1932. It was intended to continue the investigations outlined in Section 3 of the summary—"Comparison of super plus carbonate of lime with basic super"—during the 1931–32 season, and eight experiments were laid down in the South Island. On account of the extemely dry conditions prevailing at the time these trials were sown the germination in some cases was a total failure; in others the "strike" was so poor that the trials were not considered worth proceeding with, and only three were carried to completion. The results of these experiments are given in the matter which follows.

TYPE OF EXPERIMENT.

The treatments per acre in the type of experiment adopted were as follows:—

(1) Superphosphate 1 cwt. plus carbonate of lime 1 cwt.
(2) Super 2 cwt. plus carbonate of lime 2 cwt.
(3) Basic super (special) 132 lb.
(4) Basic super (special) 264 lb.
(5) Commercial basic super 119 lb.
(6) Commercial basic super 238 lb.

The superphosphate used was the commercial grade containing 44–46 per cent. tricalcic phosphate equivalent. The method of preparing "special" basic super was described in the *Journal* for April, 1932, and the probable ingredients of commercial basic super were also discussed. The guaranteed analysis of the commercial basic super used in the 1931–32 season's trials gave the phosphate content to be equivalent to 19 per cent. of phosphoric anhydride. Treatments 1, 3, and 5 specified above therefore supplied equivalent quantities of phosphate, and these contained half the quantity of phosphate of that in treatments 2, 4, and 6 respectively.

Ten replications of each treatment were sown. Each plot was 2 chains long by one width of a 7-coulter drill, and the crops were either in 7 in. or 14 in. drills according to the practice in the district.

Germination counts were taken on each crop when the plants were in the two-leaf stage. The method of determining field germination was described in the *Journals* for July, 1926, and October, 1928.

PARTICULARS OF TRIALS.

As previously stated, only three out of the eight trials laid down were carried on, due to the abnormal weather conditions, and the particulars of these individual trials are given below, together with the results which appear in Tables 1 to 3.

(1) CO-OPERATING FARMER: G. H. CROSS, OXFORD.

Previous crop: Grass, five years. Crop sown: 17/12/31. Variety: Webb's Imperial Green Globe—10 oz. per acre in 14 in. drills. Germination counts taken: 1/3/32. Crop weighed: 7/6/32.

Table 1.—Results of G. H. Cross's Experiment.

Treatment per Acre.	Germination Counts.		Yield in Tons per Acre.
	Average Number of Plants per Area, 10 ft. × 14 in.	Relative to Super 2 cwt. plus Lime 2 cwt. = 100.	
Super 1 cwt. plus carbonate of lime 1 cwt.	16·6	98·2	20·7
Super 2 cwt. plus carbonate of lime 2 cwt.	16·9	100·0	24·5
Basic super (special) 132 lb.	14·1	83·4	19·9
Basic super (special) 264 lb.	10·8	63·9	23·3
Commercial basic super 119 lb. ..	13·0	76·9	18·2
Commercial basic super 238 lb. ..	11·4	67·5	21·9

Comments on Table 1.—Germination: There is no significant difference in this respect between super plus carbonate of lime at 2 cwt. and at 4 cwt. per acre. Both, however, are significantly higher than the remainder. The germination of special basic super, 132 lb., is not significantly different from that of commercial basic super, 119 lb., but both gave significantly higher germination than the larger quantities of the respective fertilizers.

Yield: The use of the larger quantity of each fertilizer has resulted in significantly better yields than the use of the smaller quantity of the corresponding fertilizer. Commercial basic super, at 119 lb. and 238 lb. respectively, has given significantly lower yields than the equivalent quantities of special basic super and super plus carbonate of lime. Differences between the two latter were not significant.

(2) W. SYME, KIMBERLEY.

Previous crops: Wheat, 1930–31; grass, 1929–30. Crop sown: 31/12/31. Variety: Imperial Green Globe, 9 oz. per acre, in 14 in. drills. Germination counts taken: 24/2/32. Crop weighed: 17/5/32.

Table 2.—Results of W. Syme's Experiment.

Treatment per Acre.	Germination Counts.		Yield in Tons per Acre.
	Average Number of Plants per Area, 10 ft. × 14 in.	Relative to Super 2 cwt. plus Lime 2 cwt. = 100.	
Super 1 cwt. plus carbonate of lime 1 cwt.	9·5	90·5	7·5
Super 2 cwt. plus carbonate of lime 2 cwt.	10·5	100·0	8·0
Basic super (special) 132 lb.	6·5	61·9	8·1
Basic super (special) 264 lb.	5·1	48·6	8·9
Commercial basic super 1 cwt.* ..	6·9	65·7	7·0
Commercial basic super 2 cwt.* ..	5·3	50·5	6·5

* The quantities used here were based on the actual analysis of the basic super, which was equivalent to 44·7 tricalcic phosphate.

Comments on Table 2.—Germination: As in Experiment 1, there was no significant difference between the two super plus carbonate of lime treatments. Both had a significantly higher germination than the remainder. The use of 1 cwt. of commercial basic super and special basic super respectively gave a significantly greater number of plants than 2 cwt. of the corresponding fertilizer.

Yield: In view of the poor strike and patchiness of the crop it would be unwise to draw conclusions from the yields of the various treatments. An interesting point observed at maturity of the crop was that special basic super 264 lb. was free of the slight percentage of club-root found in other plots.

(3) G. H. ROSE, WAKANUI.

Previous crop: Grass. Crop sown: 12/2/32. Seeding: 8 oz. per acre in 7 in. rows. Germination counts taken: 1/3/32. Crop weighed: 29/6/32.

Table 3.—Results of G. H. Rose's Experiment.

Treatment per Acre.	Germination Counts.		Yield in Tons per Acre.
	Average Number of Plants per Area, 10 ft. × 14 in.	Relative to Special Basic Super 132 lb. = 100.	
Super 1 cwt. plus carbonate of lime 1 cwt.	15·0	90·5	25·0
Super 2 cwt. plus carbonate of lime 2 cwt.	14·2	85·5	26·2
Basic super (special) 132 lb.	16·6	100·0	25·4
Basic super (special) 264 lb.	13·4	80·7	26·4
Commercial basic super 119 lb. ..	15·8	95·2	25·8
Commercial basic super 238 lb. ..	14·2	85·5	25·5

Comments on Table 3.—Germination: Special basic super 264 lb. had a significantly lower germination than special basic super 132 lb.

Yield: There were no significant differences between the yields of various treatments.

General Comments.

Except in the case of Experiment 3, the special basic super and the commercial basic super gave a significantly lower number of plants than the corresponding quantities of super plus carbonate of lime.

In the case of special basic super, however, this did not appear to be reflected in lower yields, and in the average of the three trials the yields of special basic super are practically identical with the equivalent quantities of super plus carbonate of lime. The average yield of commercial basic super is, however, slightly less.

The use of the larger quantities of special basic super and the super plus carbonate of lime has resulted in an approximate increase of 2 tons per acre on the average, and in the case of commercial basic super the average increase was 1 ton per acre.

In each of the three experiments a plot sown for observation with 2 cwt. per acre of superphosphate without lime gave a very small yield, as the germination in each case was extremely poor.

Recommendations to Growers.

It may be advisable to reiterate statements previously made in regard to the adverse effect of super used without lime. In thirty-one trials conducted up to the present time where 1 cwt. of super could be compared with no manure, ground rock phosphate, or super plus carbonate of lime in equal parts (seed and manure in 14-in. rows) the super reduced the germination, on the average, to 65·5 per cent. of that occurring with the other treatments mentioned. Super at 2 cwt. per acre had a still greater effect on germination when sown with the seed in 14-in. rows. A comparison of super 2 cwt. with plots sown with super 2 cwt. plus carbonate of lime 2 cwt. in fourteen experiments shows that the germination of super 2 cwt. was 43·2 per cent. of that in the super plus lime plots.

In order to avoid, as far as possible, such adverse effect from the use of superphosphate with the turnip crop, farmers are advised to act on the following points:—

(1) Mix superphosphate and carbonate of lime (equal parts) at least one week before sowing. The mixture should be left in a heap, as it tends to set hard if put into bags. If left in a heap it can be easily broken up before use.

(2) Use 2 cwt. per acre of the mixture on light land, and 4 cwt. on heavier land of higher rainfall.

(3) Sowing seed and manure in 7-in. rows, instead of adopting the more common practice of sowing in 14-in. rows, has given promise of good results.

(4) If super is used without lime, the method of sowing mentioned in (3) above is recommended, or part of the super should be predrilled or post-drilled in the manner described in the *Journal* for April, 1932.

(5) The use of commercial basic super is not recommended in preference to the super plus carbonate of lime mixture. Further investigation regarding the use of the special basic super is necessary before any definite recommendation regarding its use can be made.

Mixtures of super and slaked lime in varying proportions are being tested against the super plus carbonate of lime mixture which is at present recommended.

The co-operation of those farmers who placed facilities at the disposal of the Department for carrying out these trials is cordially acknowledged. It is unfortunate that climatic conditions did not allow all the experiments laid down to be brought to a satisfactory conclusion. The field work in Experiments 1 and 2 was carried out by Mr. G. G. Calder, Instructor in Agriculture, Christchurch, and in Experiment 3 by Mr. E. M. Bates, Instructor in Agriculture, Ashburton, under the direction of Mr. R. McGillivray, Fields Superintendent, Christchurch.

—*A. W. Hudson, Crop Experimentalist, and J. W. Woodcock, Assistant Crop Experimentalist.*

SOME ASPECTS OF OVERRUN IN HOME-SEPARATION BUTTERMAKING.

Paper by D. HULL, Dairy Instructor, Dairy Division, Department of Agriculture, at the Annual Meeting of the New Zealand Dairy Factory Managers' Association, Palmerston North, June, 1932.

THE object of this address is not to treat exhaustively on the subject, but to give a review of the factors that influence the percentage of overrun obtainable in dairy-factory practice during a season's operations. Much of the data that will be quoted was obtained from observations made during a survey of overrun carried out by the Dairy Division in conjunction with five dairy companies during January of this year, and may prove to be of interest to those desirous of a fuller understanding of the factors governing overrun.

The dairy industry of this Dominion has been built up on practical work, and factory practice includes the ascertaining of the fat content and other constituents of cream and butter by practical tests. As laboratory methods of testing are outside the province of practical dairy-factory work they are omitted. Mathematical precision is unattainable with practical tests, but, so far as our experience goes, practical tests operated with due care give all the accuracy needed for commercial purposes.

The "factory" or "balance-sheet" overrun may be defined as the difference between the total butterfat that is paid for by a factory and the total of the butter for which the factory receives payment.

It is often asked, "What should an overrun be on the home-separation system?" This question is somewhat involved owing to the varying conditions existing in and around our butter-factories. The source, type, and quantities of the individual supplies of cream have a direct bearing on the possible overrun. To state definitely what the overrun should be in all factories would be obviously unfair to those factories where conditions are such that anything beyond a normal average is impossible of achievement if all suppliers get their due.

The purpose of this paper is not to indicate an arbitrary overrun, but a range in overrun is suggested for consideration. The basing of a factory-manager's efficiency on his capability to obtain a high overrun is fundamentally wrong, and has done much to bring about a spirit of restlessness concerning the pay-out of competing companies. It has forced some managers to present an overrun which they know is not in keeping with the butterfat content of the butter made under their control. It is generally conceded that, whatever the overrun may be, it is reasonable to expect that the dairy company should be in a position to justify it and also indicate that each individual supplier was given his due.

The butterfat content of the butter is the concrete base on which an overrun is built. The structure of the overrun is largely affected by the fat losses in the buttermilk, and other mechanical losses. The legal mechanical gains may be viewed in the light of reinforcing, and as a set-off against the weakening brought about by unavoidable mechanical losses during the course of manufacture.

The salient points—namely, the butterfat content of the butter, and churning and handling losses—give ample scope for an efficient manager to demonstrate his ability. While the efficient manager recognizes these two points, and endeavours to do the correct thing by his suppliers, he is placed at a disadvantage by the manager who displays little or no interest in the butterfat content of the butter and the manufacturing losses; and then presents an overrun, which, if it is not analysed, is just low enough to appear to be a fair thing. This position has arisen through some directors insisting that their factory-manager should have as high an overrun as the competing factories, without giving thought to the butterfat content of the manufactured butter.

It is just as important for a board of directors to know the average butterfat content of the butter, and the percentage of butterfat lost in the buttermilk, as it is to know the quantity of butter made and the overrun. In the past some have considered these vital points to be mere window-dressing; but the directors of a dairy company, the business of which is to make butter, should insist that these all-important facts, which have so great an influence on the true pay-out, are presented to the board at each meeting. No true opinion of an overrun can be expressed without knowledge of the facts mentioned.

Speaking generally, the highest overruns are obtained by those factories whose butter has the lowest butterfat content. This raises the question as to what could be considered to be the lowest butterfat content that a factory could average for a season. Regulations fix a maximum water and salt content for export butter at 16 per cent. and 2 per cent. respectively. 15·9 per cent. can be considered to be the maximum water content, and 1·9 per cent. the maximum salt content that could be averaged by a factory for a year. Other than the butterfat, the remaining constituents by short analysis of the butter are curd and ash. Dairy Division experience has been that the curd and ash content of New Zealand butter seldom exceeds 0·9 per cent., and we have yet to learn of any factories averaging over 0·9 per cent. of curd and ash for a season. Therefore, 0·9 per cent. could safely be considered to be the maximum average content obtainable in this Dominion.

With 15·9 per cent. average moisture, 1·9 per cent. average salt, and 0·9 per cent. average curd and ash contents, one would have 81·3 per cent. of butterfat. 81·3 per cent. of butterfat can confidently be considered to be the *minimum* average butterfat content for export butter, and I am of the opinion that no factory in this country has had an average butterfat content for export butter this season as low as 81·3 per cent. I will refer to this figure again later.

At this stage I wish to stress the fact that the striving for high moisture content is often responsible for overworked butter, and its attendant evils of "flat" flavour and reduced "keeping" quality. Speaking as I am to a gathering of skilled makers, you will follow my meaning when I say that the working process should be stopped when the body and texture of the butter is "just right," rather than carry on to overworking for a small percentage of extra moisture content. We must not lose sight of the fact that quality must be foremost.

The apparent gain of a small percentage of extra moisture is too costly if made at the expense of quality.

It is also desired to stress the point that butters containing 1·8 to 2 per cent. of salt are too highly salted for the best trade in the United Kingdom. It would not be in the interests of the extension of the consumption of New Zealand butter if all our butter contained this high percentage of salt. Factory-managers who are endeavouring to make a butter which will best please customers in the high-class trade will, it may be assumed, be endeavouring to keep the salt content in the vicinity of 1·6 to 1·7 per cent. We have received information that a section of the trade in the United Kingdom consider that butter containing 1·7 per cent. is just over the border of salting for their best trade. Nationally we are sellers of butter, not buyers. We have to realize that we must give those who buy from us just what they ask for, and not what we may consider to be "near enough."

Mechanical Losses of Butterfat.

I now wish to touch on the matter of unavoidable losses in manufacture. The butterfat lost in the buttermilk constitutes the greatest percentage of the total losses. The skill and knowledge of the factory-manager have a direct bearing on this loss. Our investigations show a range of from 1·033 per cent. to 2·614 per cent. of the total fat as being lost in the buttermilk. Correct temperatures and correct pasteurizing and cooling equipment are necessary if this loss is to be reduced to a minimum. Restricted outlets from pasteurizers, the use of certain types of cream pumps, and neglecting to thoroughly stir the cream in the holding vats are prime causes of undue loss of fat in the buttermilk. With the equipment used in New Zealand factories at the present time, it is unlikely that any factory would lose less than 1 per cent. of its total butterfat, in the buttermilk, for a season.

The average loss of fat sustained in a well-managed factory by giving away 2 oz. of butter per box can be put down as representing 0·233 per cent. of the total butterfat. This figure was fairly constant in our experimental work. Some work was also done in connection with the butterfat content of butter wash-water. Some samples gave a reading as high as 0·02 per cent. with the butyl alcohol test.

The amount of butterfat lost in manufacture due to cream samples, spillage, adherence to cans, vats, churns, &c., varies considerably and cannot be exactly determined. It is thought by some that practically no loss occurs under this heading. But it is not physically possible to handle cream and make butter without these losses, which are constant. They can be fairly assessed at 0·5 per cent. of the total butterfat received. If the handling losses were as low as 0·25 per cent. or as high as 0·75 per cent., the overrun would only be affected by approximately 0·3 per cent. either way. While congratulating the ultra-careful manager on reducing spillage and handling losses to a minimum, his zeal in this connection does not lift the overrun to the extent that some suppliers believe. It is also recognized that the percentage of butterfat lost in handling is greater in a small factory than in a large one.

Experiments and investigations have shown that the minimum manufacturing losses in a well-managed factory are in the vicinity of: Buttermilk, 1·0 per cent.; butter trade allowance, 0·233 per cent.;

handling, spillage, &c., 0·5 per cent.—making altogether 1·733 per cent. of the total fat. I wish to make it quite clear that these figures should be taken as a *minimum*. Our experience has been that this minimum has seldom been obtained.

As an indication of the variations in mechanical losses that do and will occur as between factories the following figures are given :—

Factory.	Fat in Buttermilk.	Fat in Butter Trade Allowance.
	Per Cent.	Per Cent.
A	1·033	0·2618
B	1·149	0·181
C	2·614	0·2312
D	1·251	0·217

Factory C experienced heavy churning losses on account of the type of machinery used for pasteurizing and cooling, and must be taken as being exceptional.

The *average* total butterfat loss in the average factory may be considered to be : Butterfat in buttermilk, 1·144 per cent. ; butterfat in trade allowance, 0·233 per cent. ; spillage, handling, and sampling losses, 0·7 per cent.—making 2·077 per cent. of the total butterfat.

It may be considered by some that an average of 0·7 per cent. for the items of spillage, handling, &c., is on the high side ; but the fact has to be acknowledged that cream sampling is nearly always in favour of the supplier, and although inaccuracy in sampling is not an actual loss the overrun is depreciated thereby.

To sum up on mechanical losses, these can be taken in round figures as representing 2 per cent. of the total butterfat received.

Mechanical Gains on Cream and Cans.

The Dairy Regulations provide that where the weight of cream received from a supplier is not an exact number of half pounds it shall be recorded at or above the nearest half pound below the exact weight ; and if the cream is weighed in a container, and the container weighs an exact number of half pounds, the tare of the container shall be computed accordingly ; and where the weight of the container is not an exact number of half pounds the tare shall be computed at or below the nearest half pound above the weight of the container. Thus it will be seen that it is possible to gain up to 7 oz. on the weight of a parcel of cream, and up to 7 oz. on the tare weight of the can.

In the first case the law of averages will operate, and the average gain on the weight of each parcel of cream will be 3½ oz. In the second case the law of averages will take charge at the time the cans are manufactured, but there is a chance that a majority of the cans going to a butter-factory may be of such weights as to constitute a greater gain than the average can would give. Nevertheless, the average theoretical gain on the tare weight of each can is 3½ oz., and it would appear that the time has arrived when dairy companies should check up the weights of the cans received, and bring the weights of each can to the nearest pound or half pound. Briefly, the law of averages provides that the mechanical gains in weighing cream and cans will be approximately 0·875 per cent. of the total butterfat.

Our experience over a period of ten days at different factories gave the following variations in gains on cream weights and can tare weights :—

Lowest gain on tare of cans over a period of 10 days=0·159 per cent. of total butterfat.

Highest gain on tare of cans over a period of 10 days=0·438 per cent. of total butterfat.

Lowest gain on fractions in weighing cream over a period of 10 days= 0·211 per cent. of total butterfat.

Highest gain on fractions in weighing cream over a period of 10 days= 0·361 per cent. of total butterfat.

Combining the gains on fractions of cream and gains on the tare weight of cans, the following figures result :—

Lowest bracketed gains on cream and cans over a period of 10 days= 0·381 per cent. of total butterfat.

Highest bracketed gains on cream and cans over a period of 10 days= 0·799 per cent. of total butterfat.

Although no single factory during the experimental work averaged as high a gain under these headings as the theoretical gain based on the law of averages, that does not prove that the law of averages will not obtain over a season's operations.

Mechanical Gains on Tests.

When cream tests are being read at a factory it is usually the practice to read to the nearest 1 per cent., and half points and smaller fractions are retained by the factory. Some factories, however, do not follow the good policy of "give and take," but take advantage of all fractions of tests up to 0·9 per cent. Thus, the average gain of this type of factory will be approximately 1·125 per cent. of the total butterfat.

Our experience at different factories over a period of ten days gave the following variations in gains on cream-test fractions :—

Lowest gain on fractions of cream tests over a period of 10 days = 0·563 per cent. of total butterfat.

Highest gain on fractions of cream tests over a period of 10 days = 1·305 per cent. of total butterfat.

Although one factory during the experimental work of ten days' duration did average a higher gain under this heading than the theoretical gain, that does not prove that the law of averages will not obtain over a season's operations. I think that it will be agreed that the average mechanical gains on the fractions of cream tests are too high a percentage of the butterfat received. This particularly applies to the factory that does not "give and take."

I would draw attention to a later type of cream test bottle that was introduced to this Dominion by Massey Agricultural College. This is a 9-gramme 50 per cent. bottle graduated to 0·5 per cent. and read direct. This obviates the doubling of the reading as is the case with the ordinary 30 per cent. bottle. As the bottles are graduated to 0·5 per cent. the half points are clearly defined, and in many instances a quarter point is obvious. It is recommended that this new type of bottle be used in future, and that no further orders for 30 per cent. bottles be given.

A further gain accrues if a factory does not pay for the fractions below 1 lb. in weight of the supplier's total weight of butterfat for the testing period or the month. Some company secretaries adopt the "give and take" principle when getting out the monthly butterfat statements. Others take the fractions from all three periods of the month. Experiments in conjunction with the Dairy Division have shown a possible gain of 0·3 per cent. of the total butterfat paid for if all fractions under this heading are taken. Those responsible for figuring the period and monthly butterfat totals are strongly recommended to adopt the "give and take" principle, as a factory is not likely to lose by so doing.

Total Mechanical Gains.

Summing up the *total* mechanical gains, our experience at different factories over a period of ten days gave the following variations:—

Lowest total over a period of 10 days = 0·944 per cent. of total butterfat.

Highest total over a period of 10 days = 2·077 per cent. of total butterfat.

The theoretical total of gains, based on the law of averages, would be approximately 2 per cent. of the total butterfat. But the average total gains in five factories during the same period of experimental work did not reach that figure. This, however, does not prove that the law of averages would not obtain over a season's operations.

Other Considerations.

Earlier in this address I referred to the matter of the source, type, and quantities of the individual supplies of cream to a factory. I would here mention that the factory with the greatest number of daily suppliers per ton of butter manufactured will average the greatest percentage of mechanical gains, particularly if each can is weighed separately.

Before a maximum overrun could be fairly fixed, conditions such as I have just mentioned would also need to be fixed. This is impossible of achievement. It has been demonstrated that it is possible for the mechanical gains to equal and counterbalance the mechanical losses, but I wish to make myself quite clear when I say, "Do not go back to your factories feeling convinced that *your* gains will always equal *your* losses; that can only be the case when your mechanical losses are low, and when the source, type, and quantities of the supplies of cream are such as to warrant your mechanical gains." It is my personal conviction that in most factories the losses are heavier than the gains over a season.

Reiterating the fact that the butterfat content of the butter is the concrete base on which overrun is built, and allowing that under well-defined circumstances it is possible for the gains to equal the losses, the conclusion is that it is also possible for the "factory" or "balance-sheet" overrun to equal and be in line with the overrun based on the average composition of the butter manufactured for the year.

I said earlier that I would again refer to what could confidently be considered to be the minimum average fat content for export butter

for a season, the composition being as follows: Butterfat, 81·3 per cent.; water, 15·9 per cent.; salt, 1·9 per cent.; curd and ash, 0·9 per cent.: total, 100 per cent. If it is possible to average this composition, then the "composition" overrun would be 23·0 per cent. and a "factory" or "balance-sheet" overrun of 23·0 per cent. could be justified; but any excess of mechanical losses over mechanical gains would, of course, reduce this overrun accordingly.

The average composition of the butter exported from New Zealand is very near the following: Butterfat, 82·0 per cent.; water, 15·5 per cent.; salt, 1·7 per cent.; curd and ash, 0·8 per cent.: total, 100 per cent. Under exceptional circumstances with this average composition the "factory" overrun could be 21·9 per cent., which is the same as the overrun on the composition of the butter. As with the previous overrun, any excess of mechanical losses over mechanical gains would reduce the overrun accordingly.

Standardizing of Overrun.

It has been suggested that the overrun in butter-factories should be standardized, and that all butterfat exceeding certain prescribed limits should be credited back to the suppliers as such, and not included as overrun.

Consideration has been given to other methods of payment for butterfat, and the conclusion arrived at is that any other methods of payment would be more costly to use. The present method is a satisfactory one, provided that it is operated in a fair spirit. If overruns were standardized it is to be expected that the maximum would soon become the minimum—in fact, some directors would possibly demand it, and it is possible that some managers would soon be in the position of publishing a higher overrun than they could justify by the average butterfat content of the company's butter.

Conclusion.

In conclusion I wish to say that as a dairying country quality must always come first with us. Striving for 15·9 per cent. of moisture, 1·9 per cent. of salt, and an excessive curd content, is not in the interests of quality. Our best butters are not made on these lines. As makers, you know this to be true. Butter containing 0·9 per cent. of curd and ash could be termed a doubtful keeper. Any considerations such as I have just mentioned should be made subversive to quality. If overrun is placed before quality, then it may be said definitely that the principle is commercially unsound.

Testing of Export Butter for Moisture and Salt Content.—The annual report of the Dairy Division for 1931–32 refers to this matter as follows: "The usual practice of testing a box from each churning of butter sent forward for grading was followed, and during the year 153,985 churnings were tested. A high degree of accuracy in the incorporation of water in the butter has been maintained by buttermakers, and only 0·4 per cent. of these churnings exceeded the legal limit of 16 per cent. The butter showing excess water was, of course, not exported. In addition, 99,015 samples were tested for salt content, the legal requirement of which ranges from 1·5 to 2 per cent. A tolerance of 0·25 per cent. below the legal minimum has been permitted, and a very small percentage of churnings was found to be outside this range; these were withdrawn from export."

SEED CERTIFICATION.

SUMMARY OF OPERATIONS FOR SEASON 1931–32.

(Concluded from November.)

Reported by J. H. CLARIDGE, Assistant in Agronomy, Department of Agriculture.

Seed Wheat.

The results of the introduction of fixed standards in connection with wheat certification in 1930–31 are shown in the figures for the 1931–32 season. In the latter season, of fifty-seven farmers' crops inspected, only one crop was rejected on account of the presence of a high percentage of loose smut, while five crops were rejected on account of a high percentage of foreign varieties. Of these five, two rejections were attributable to the fact that some other variety of wheat had first been sown, but had not given a satisfactory strike.

Table 7.—Seed-wheat Certification: Number of Areas and Acreage inspected and passed in the Field, Season 1931–32.

Variety.	Areas inspected.		Areas passed.	
	Number.	Acreage.	Number.	Acreage.
Solid-straw Tuscan ..	22	503	16	382
	(76)	(2,178)	(9)	(129)
College Hunter's II ..	20	335	15	273
	(2)	(25)	(2)	(25)
Other varieties ..	22	225	16	155
	(58)	(1,086)	(16)	(231)
Total	64	1,063	47	810
	(136)	(3,289)	(27)	(385)

Table 8.—Seed-wheat Certification: Quantities branded in the Paddock and Machine-dressed, Season 1931–32.

Variety.	Areas passed Grain Inspection.		Number of Sacks branded in Paddock.	Bushels of Seed going into Machines.	Bushels of Machine-dressed Seed obtained.	Percentage of Loss in Machine-dressing.
	Number.	Acreage.				
Solid-straw Tuscan	7	106	621	..	..	..
	(4)	(71)	(815)	(1,686)	(1,540)	(8·7)
College Hunter's II	6	69	604	509	468	8·1
	(2)	(25)	(538)	(129)	(107)	(17·1)
Other varieties ..	7	78	539	944	815	13·6
	(9)	(156)	(1,814)	(2,828)	(2,413)	(14·3)
Total ..	20	253	1,764	1,453	1,283	11·7
	(15)	(252)	(3,167)	(4,643)	(4,060)	(12·6)

The other three rejections were crops of the College Hunter's variety, which has been replaced by a later selection, College Hunter's II. Reference to the 1930–31 records shows that at least 75 per cent. of the crops inspected in that season were rejected on account of one or other of the above-mentioned reasons. Twenty-eight of the crops which passed field inspection were subjected to the grain inspection. Eight of these were rejected, the high proportion being due to the seasonal conditions producing wheat unsuitable for seed purposes.

Tables 7 and 8 compare the results of the season's work with those of the previous season.

Seed Potatoes.

Final figures in connection with the total quantity of seed potatoes passing the tuber inspection in 1930–31 were not available when the summary of operations for that season was prepared. Table 9 gives these figures for the last five years, illustrating the increase in the quantity of seed tagged.

Table 9.—Potato Certification: Quantity of Potatoes finally certified.

Variety.	1927–28.	1928–29.	1929–30.	1930–31.	1931–32.
	Tons.	Tons.	Tons.	Tons.	Tons.
Aucklander Short-top ..	18	85	176	390	438
Dakota	77	96	174	113	116
Aucklander Tall-top ..	14	14	50	73	81
King Edward	..	2	30	46	45
Epicure	..	..	13	37	9
Arran Chief	27	18	1	25	41
Other varieties	81	34	67	76	81
Total	217	249	511	760	811

There was a drop in the number of applications received for the 1931–32 season, a reduction of twenty-eight being recorded on the previous season's figures. This reduction may be accounted for in

Table 10.—Entries and Inspections of Seed Potatoes, Season 1931–32.

Item.	Number.			Percentage.			Acreage.		
	1931–32.	1930–31.	1929–30.	1931–32.	1930–31.	1929–30.	1931–32.	1930–31.	1929–30.
Crops entered ..	336	364	397	..	..	..	..	..	..
Crops withdrawn	34	17	34	..	..	..	..	..	..
Crops inspected	302	347	363	..	..	..	1,131	1,334	1,200
Crops rejected on account of rogues	11	23	84	3·6	6·6	23·5	25	83	..
Crops rejected on account of virus disease and cropping power	98	84	151	33·7	25·3	54·2	350	290	..
Crops provisionally certified	193	240	128	64·2	69·2	35·3	756	950	590

that in 1931 the potato market in New Zealand reached an unprecedented low ebb, with a resultant estimated reduction of 20 per cent. in the total area planted in the spring of 1931 as compared with that planted in 1930.

The position in regard to entries and inspections is given in Table 10, where the 1930–31 figures are also included. While there has again been a reduction in the percentage of crops rejected on account of foreign varieties, the percentage rejected for virus disease and cropping power shows an increase from 25 per cent. to 33 per cent. When it is mentioned that the standard for the 1931–32 crops was higher than previously, this increase is immediately explained.

Table 11 shows the distribution of all lines according to district of origin.

Table 11.—Seed Potatoes: Crops provisionally certified or rejected arranged according to District, Season 1931–32.

District.	Inspected.		Rejected.				Provisionally certified.	
			For Rogues.		For Virus and Cropping Power.			
	Crops.	Acreage.	Crops.	Acreage.	Crops.	Acreage.	Crops.	Acreage.
Manawatu	10	29	3	7	6	19	1	3
Wairarapa	3	4	..	..	1	1	2	3
North Canterbury ..	185	870	7	17	52	202	126	651
Mid-Canterbury ..	16	98	..	..	7	63	9	35
South Canterbury ..	35	85	1	1	19	49	15	35
North Otago ..	6	10	..	..	4	7	2	3
Otago	4	16	..	..	1	6	3	10
Southland	18	34	..	..	1	3	17	31
Total ..	277	1,146	11	25	91	350	175	771

NOTE.—This table does not include small areas of twenty-five varieties entered by the Government Pure Seed Station, Lincoln.

Table 12.—Potato Certification: Number of Crops and Acreage provisionally certified, 1929–30 to 1931–32.

Variety.	Number of Crops.			Acreage.		
	1929–30.	1930–31.	1931–32.	1929–30.	1930–31.	1931–32.
Aucklander Short-top ..	26	80	57	96	298	352
Dakota	27	58	29	132	270	145
Aucklander Tall-top ..	8	25	23	56	86	92
Arran Chief	3	5	13	6	18	26
King Edward	9	14	11	25	30	21
Up-to-date	2	5	11	3	11	22
Epicure	5	9	8	29	56	31
Iron Duke	1	6	5	12	23	7
Bresee's Prolific ..	7	8	4	78	107	31
Other varieties ..	14	24	31	43	45	44
Total	108	240	193	492	950	771
Average acreage of areas	..	..	..	4·6	4·3	4·4

The range of varieties provisionally certified, together with the acreage, is given in Table 12, where comparisons may be made with the two previous seasons.

The number of samples received in connection with the qualification trials fell from 218 in 1930–31 to 91 in 1931–32, a decrease which seems hardly explained by planting fluctuations. Further, the general standard of the lines entered, as given in Table 13, hardly came up to that of the previous season, even allowing for the tightening of the standards. In connection with this table, in Class A are included lines which are recommended for entry into certification, while Class B contains crops about the borderline, which the grower may enter if he feels so disposed. In Class C are placed the crops which are definitely of no value in certification.

Table 13.—Seed Potato Qualification Trials, Season 1931–32, showing Origin and Classification of Lines.

District of Origin.	Number of Varieties.	Number of Entries.	Number of Entries classified as				
			Class A.	Class B.	Class C.	Too mixed to judge.	Insufficient Commercial Importance.
Hawke's Bay – Manawatu	7	15	3	..	10	1	1
	(3)	(5)	(1)	(1)	(2)	..	(1)
North Canterbury ..	14	35	..	6	27	1	1
	(36)	(132)	(32)	(24)	(51)	(17)	(8)
Mid-Canterbury ..	4	5	..	2	3	..	..
	(4)	(11)	(6)	..	(3)	(2)	..
South Canterbury ..	10	19	1	2	14	2	..
	(21)	(48)	(2)	(3)	(31)	(7)	(5)
North Otago ..	4	7	..	1	4	2	..
	(3)	(3)	..	..	(2)	(1)	..
Otago	3	3	..	1	2	..	..
	(3)	(5)	..	(2)	(1)	(2)	..
Southland	4	7	2	4	1	..	..
	(6)	(14)	(4)	(5)	(1)	(2)	(2)
Total ..	22	91	6	16	62	5	2
	(52)	(218)	(45)	(35)	(91)	(31)	(16)

Seed Beans.

The certification of seed beans has proved to be very disappointing. Of all the Canadian Wonder crops inspected there were only two small areas in which no bean-wilt could be found. The seed sown on these areas was raised the previous season in an isolated area. Other varieties do not appear so susceptible to the disease, and of these a fair proportion was accepted.

Exportation of Stud Stock.—During the year ended 31st March, 1932, the following stud stock was exported from New Zealand: Sheep, 1,434; cattle, 46; swine, 11; horses, 11 (draught). There was the usual movement of racehorses to and from Australia.

SEASONAL NOTES.

THE FARM.

The Pastures.

A CONSIDERABLE proportion of the poor results obtained from the autumn sowing of pasture seed mixtures arises either from sowing at too late a date or from sowing on a coarse, poorly consolidated seed-bed. Frequently both late sowing and poor seed-bed are due to not allowing sufficient time for preparatory cultivation. Intensive tillage for a short period may be employed to produce a fairly well pulverized seed-bed, but it is advisable to remember that hurried tillage necessarily eliminates the action of natural weathering agencies which experience has shown to be of great service in producing economically the fine firm seed-bed that favours really successful pasture establishment.

If a seed-bed is not fine and firm the covering of seeds takes place at greatly varying depths, and consequently if some of the seeds are sown at a suitable depth others must be sown at unsuitable depths ; in pasture seeds, which are relatively minute, the danger is that a substantial proportion will be buried so deeply as to make it impossible for seedlings to be established from them. As good pasture seed is relatively expensive it is as a rule not sown in excessive quantities. Indeed, probably the amount used is frequently inadequate to produce a sward of maximum efficiency. Hence poor seed-beds are particularly likely to lead to weaknesses appearing in pastures right from their initial stages. Even when possible, it is seldom easy to remedy such weaknesses. It must be concluded from these facts that the preparatory cultivation of land for new pastures should be commenced, as a rule, at least a few weeks before it is intended to sow the seed.

The seeds for pasture mixtures are at times purchased in a hurried haphazard manner. In view of the fact that the harmful influence of unsuitable mixtures may be felt over many years, it is much more important with permanent pastures than with annual crops to exercise great care in securing the seed best suited for the specific purpose. This at times cannot be done quickly, because several matters call for attention. Even when it has been decided what species are to be used and the quantities of each to be included, information has to be obtained about the strain and the germination capacity of the lines of seed offering. Hence it is clearly wise not to leave the purchase of pasture seed mixtures to the last day or so before their sowing, as is so often done.

Seed of poor type or poor germination capacity is at times offered at what seems to be an attractively low price. As a rule, such seed is markedly dear at such a price. Against this is the fact that each year considerable quantities of seed poor in strain or poor in germination find ready purchasers, thereby indicating that some farmers do not yet realize the true economy of good seeds for permanent pastures.

One of the most important recent advances in grassland is the more thorough knowledge of strain differences within certain important pasture species which formerly were widely accepted without question as being relatively uniform in character. It has been demonstrated strikingly that certain strains are outstandingly superior to others within the same species. No farmer can obtain full efficiency and ignore in his seed purchases the present knowledge of strain differences in pasture species. Full information regarding strains of pasture species and about pasture seed mixtures generally may be obtained by applying to local officers of the Fields Division.

Areas from which hay or silage has been saved will usually respond profitably to a dressing of superphosphate, especially if relatively early mowing has taken place and if the top-dressing is carried out as soon as the mown material has been removed. The quick stimulation of growth which can at times be obtained by the use of superphosphate in this manner is likely to be particularly valuable, because it leads to the provision of additional fresh grass at that critical period in summer when such fresh feed is apt to be harmfully scant.

Especially in a summer favourable for growth precautions should usually be taken to avoid the production of seed by recently sown pastures during their first year, and such precautions are particularly advisable if the young pastures were designed for permanent ones and so contain slowly developing as well as relatively quickly developing species. If seed production is allowed to take place in the youth of such pastures, injury of the valuable more slowly developing species may be expected.

Not usually, but occasionally, it will prove advantageous to allow worn-out pastures to run to seed in summer, provided such pastures contain satisfactory numbers of useful species which it would be worth while to increase by reseeding. If such reseeding occurs the pasture should be harrowed drastically in the autumn when the seed has ripened, and when rains sufficient to induce safe establishment of the seedlings may be expected. Under favourable circumstances such management may prove useful as a means of increasing the density of a sole of grass, especially when, for particular reasons, ploughing up of an open turf is either not desirable or not possible. However, it is well to remember that if the valuable species which it is desired to increase have fallen in numbers because of unduly low fertility, then reseeding will fail to achieve a permanent increase in their numbers unless the fertility of the area is suitably increased by top-dressing and other effective measures. Further, repairing of weakened swards by reseeding is frequently an inferior alternative to ploughing and regrassing, when these measures are practicable, as a means of obtaining improved swards.

Paramount Importance of Summer Cultivation in Crops.

Early summer brings an intensive need for much cultivation. In field work it has been demonstrated, both frequently and strikingly, that the liberal use of expensive and appropriate fertilizer and the sowing of adequate quantities of the best available seed are at most only partly effective unless linked up with adequate cultivation. Cultivation is an excellent means of minimizing much of the trouble from weeds in arable crops, but if it is viewed solely as a measure against weeds, then the amount of cultivation done is likely to be very inadequate. One of the most valuable further effects of surface cultivation in summer is the checking of the escape of moisture by evaporation from the surface of the land. This influence may be of basic importance in dry districts or dry seasons, and is normally of considerable moment in that extensive portion of New Zealand which experiences not more than 35 in. of annual rainfall.

The importance of suppression of weeds in summer, which seems at times to be underestimated, arises primarily from the ready manner in which weeds rob crops of their supplies of moisture from the soil and of direct sunlight, which are essential to growth. It is not always realized that often the greatest harm done by weeds is the cutting-off from the crops of their supplies of sunlight. Even in a soil characterized by abundant fertility, including ample moisture, crops develop very unsatisfactorily if the supply of direct light is cut off. This points to the wisdom of keeping thoroughly free from weeds those crops sown in rows wide enough apart to allow suppression of weeds to be carried out. It means that such crops as mangels, potatoes, and carrots should be " cleaning crops " in fact as well as in name.

Cultivation is the key to the growing of true cleaning crops, and too often crops which in theory are cleaning crops are raised in a way which actually fouls the land with weeds.

Apart from its beneficial influence on moisture-supply and weed-control, cultivation is of value as a means of bringing about aeration of the soil. Good aeration favours the readier utilization by the crop of the raw material for its nourishment which occurs in a soil.

For crops such as swedes, which are still to be sown, preparatory cultivation as distinct from inter-tillage will in many instances be calling for attention, and if it is considerably delayed correspondingly poor crops may be expected.

Forage-crop Considerations.

Often in early January it is useful to consider whether further strengthening of the supply of feed for winter and early spring should be arranged. For this purpose a temporary pasture, obtained by sowing 25 lb. to 35 lb. of Italian rye-grass and 4 lb. to 6 lb. of red clover an acre, may often be usefully employed. It is good practice to sow such a crop in late summer or early autumn, and it should be sown early enough to ensure a substantial supply of winter feed. It can be counted upon under normal circumstances to yield a heavy crop of hay or silage in the following season.

When the land available for summer or autumn sowing will be required again for spring sowing, then instead of temporary pasture a catch-crop of oats or black skinless barley should usually be employed. Both crops ordinarily give good results when about 2½ bushels of seed to the acre are sown. Often, and particularly in the South Island, autumn-sown temporary pastures and cereals for green feed are not sown early enough to give the best possible results. With these crops a dressing of 1 to 3 cwt. of superphosphate per acre is usually well justified. These crops, if grown after turnips which have been used at a comparatively early date or after a cereal crop, may at times be grown quite satisfactorily with a very small amount of preparatory cultivation—disking may give sufficient tilth for the seed-bed needed.

Turnip and swede sowing which remains to be done at the end of the year should be carried out at the earliest opportunity. In most localities after the middle of January it is safer to sow turnips than swedes. This is both because the turnips develop more quickly than the swedes, and because they do not suffer so severely as swedes from the ravages of insects which attack these crops in summer and autumn. The Hardy and Imperial Green Globe varieties of turnips are suitable for January sowing. Both turnips and swedes will usually respond profitably to a fertilizer dressing of 2 to 3 cwt. an acre. In such a dressing it is advisable to make superphosphate prominent, and often bonedust may be suitably included.

At this period thinning of such crops as mangels and carrots, if incomplete, should be carried on as speedily as possible, and if the seedlings are pale and seem not to be thriving sufficiently a dressing of about 1 cwt. of nitrate of soda per acre, scattered along the rows close to the plants and hoed in after thinning, may be well worth while.

General Cropping Work.

Because of the invasion of weeds lucerne sown in November or December may require mowing towards the end of January, but, unless the weeds are threatening to injure the stand, young lucerne should not be mown so early. If the young crop can be left unchecked longer this favours the development of a vigorous and extensive root-system which is likely to be of service to the crop in subsequent competition with invading plants. Although

experience justifies a preference for November or December sowing, a sowing of lucerne may be made successfully in January in many districts, if necessary.

Potatoes justify considerable attention at this season. In addition to weeding they will usually need moulding up and possibly spraying for late (or Irish) blight. Especially in districts in which the blight is likely to be severe, spraying proves more effective when utilized as a means of preventing rather than of destroying attacks of the blight. To prevent blight, spraying must be carried out in good time. As a rule better and cheaper work results from the use of sprays prepared on the farm instead of from purchased ready-made spraying materials. But spraying is likely to be futile or injurious unless the spray material is suitably prepared. Recently a modified improved method of preparing Bordeaux mixture, which is recommended for spraying potatoes for the control of blight, has been introduced by the Mycologist, Plant Research Station. A description of this method may be obtained by applying to local officers of the Fields Division.

The cutting of cereal crops at the most suitable stage of ripeness is important. Investigation has shown that it is best to cut wheat when the green colour has been replaced by yellow in the section between the top knot and the head of about 99 per cent. of the straws. At this stage all knots are still green, and while dough cannot be squeezed from the grains they are still soft enough to cut with the thumb-nail.

Generally, oats should be cut when they have a uniform yellowish appearance, but before the final touch of green has disappeared. At times oats for chaff are cut when too ripe; for chaff they can well be cut slightly earlier than the stage just described.

Frequently the use of special crops to supplement the pastures is not commenced early enough in the summer in the case of milking-stock. If, as often happens on many farms, the pastures are woody or stemmy from Christmas onwards, they no longer by themselves provide suitable feed for milking-stock. Many farmers, however, pay attention only to the ample bulk of feed available and overlook its lack of characteristics essential for fully efficient milk-production. And so they mistakenly delay starting to use suitable crops, such as early-sown, quickly-maturing soft turnips, young green lucerne, or fresh aftermath of pastures, which are available.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Thinning of Fruit.

ALTHOUGH the main thinning will have been carried out after the November drop, the grower usually finds as the season advances that the operation has not been sufficiently severe, and a second and sometimes a third operation becomes necessary. Fruits attacked by either fungi or insects may be removed with advantage at this latter stage.

The main objects of thinning may be summarized as follows: The removal of a due proportion of fruits gives to the remainder sufficient room for their full development. Having in view the vigour and crop capacity of the individual tree, the operation may be cited as one of the important factors influencing annual cropping. Production costs will be lowered through a small proportion of culls, handling will be appreciably facilitated, and the health of the tree be conserved. Broken limbs and the use of additional props are usually indicative of insufficient thinning.

Cultivation.

From mid-season onwards the fruits will be swelling rapidly, and should drought conditions be experienced light cultivation will still be necessary.

Serious damage sometimes occurs when this operation is done too deep. Interference with the small feeding rootlets at this stage is often reflected in severe droppings and loss of foliage. Orchards so situated that scouring occurs after heavy rains will require provision for an early green cover-crop.

Spraying.

In those districts where periodic rainfalls may be anticipated there should be no slackening in the summer spray programme. Provision will probably have to be made for the addition of nicotine sulphate where necessary. Black-spot affecting the foliage may be curtailed and prevented from an extension to fruits if a timely application of a fungicide is made and not more than forty-eight hours has elapsed in the interim.

Botrytis-rot injury in the calyx has been observed on several varieties for a number of years, more particularly on King David and Dougherty. Recent investigations indicate that the initial injury is due to soluble arsenic and that the rot is a secondary result. The addition of lime or sulphate of iron to the lime-sulphur and arsenical spray mixture is suggested as a partial controllant of the injury.

Harvesting.

When opportunity offers, the grading-machine should be given a general overhaul, and special care should be given to those makes having cord on the rollers. Rubber tubing of similar dimensions tacked on has been found to be an effective substitute for the cord.

Where arrangements have not already been made for the supply of all the necessities for handling the crop, such as cases, nails, wiring-machine, &c., no time should be lost in securing supplies.

Fireblight.

Uncontrolled hawthorn infection of fireblight, or neglect to remove apple and pear spurs on which blossom infection occurred, may be the cause of attack on succulent young growth through oozing. Leaf discoloration will give an early indication if this condition exists, when early cutting out and destruction are necessary. Disinfection of both the cut surface left and the tools in use is essential. The following compound is recommended as a sterilizer: Mercuric chloride, 1 gramme, hydrochloric acid, concentrated, 15 c.c., water, 1,000 c.c.

—H. F. Frost, Orchard Instructor, Wanganui.

Citrus Culture.

It will be necessary for some time to continue all routine work, such as spraying for the control of the various diseases, cultivation, pinching young shoots where necessary, or perhaps taking out young misplaced shoots.

At this season of the year young trees should receive particular attention, and where an excess of growth is indicated some judicious pinching or rubbing out of young shoots may be necessary. It is by small operations such as this that a good foundation can be laid that will make for future success. If the trees require a little fertilizer this should be given in the form of blood and bone, working lightly into the soil about 1 lb. per tree.

It will be noticed that often young trees only a few years from planting show an abnormally large quantity of blossoms, while the wood growth is very poor. Where this takes place it can safely be assumed that the trees have either been worked on to faulty stocks or else the soil is unsuitable for the purpose of citrus growing. If the stocks are at fault very little can be done to bring about any improvement. Moreover, where the soil is unsuitable citrus fruits will never be grown successfully. In localities where the climate and soil are both suitable, and where the necessary shelter has been provided, the young trees should come away very quickly and soon become fruit-producing.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Feeding the Layers.

FEEDING the laying birds to the best advantage at this season when they are producing their maximum egg yield is imperative if they are to prove really profitable. On the other hand, it is a mistake to provide a rich forcing diet. Nitrogenous material is essential to heavy egg-production, especially in the colder months of the year, but the supply of meat and meat substitutes, &c., requires to be controlled with considerable caution, or ovarian trouble, such as protrusion of the oviduct, will result.

In feeding fowls the special conditions must always be taken into consideration. For example, birds on free range do not require the same proportion of forcing food as birds in close confinement, and the demand for such material varies according to the birds' laying condition as well as according to their laying capacity. A case came under my notice recently where ovarian disorders were causing heavy mortality in a flock which had a good range, were given milk to drink, and had a big supply of meat-meal in the mash, while some special spice was also included in the mixture. It was easy in these circumstances to point to the cause of the trouble. In this case meat-meal was not required at all.

The weakness of an oversupply of meat food is accentuated where the supply of grain, pollard, &c., is not as liberal as it should be, the poultryman frequently reasoning that an extra supply of meat-meal will make up for the poor supply of the grain material. If meat-meal is fed in a separate receptacle and the birds are allowed to balance their own ration the risk of ovarian disorders will be greatly minimized, but where such a rich food is mixed with the mash and the same ration fed to all members of the flock, whether they be in their first, second, or third laying season, the procedure is decidedly risky.

With regard to condiments, the best argument to prove the futility of feeding these to laying birds for consistently stimulating egg-production is that the high records put up at the laying competitions are established without their aid.

The Function of Grit and Sea-shell.

The value of grit for the maintenance of fowls in a healthy thriving state can hardly be exaggerated; it should be always available to birds of all ages to pick at. Fowls have no teeth with which to masticate their food, and grit acts as a substitute, hence proper digestion cannot take place unless the gizzard contains sharp gravel-grit or similar material, and without good digestion a bird cannot maintain good health and strong bodily vigour. The lack of grit is often responsible not only for a reduced egg-yield, but is also a frequent cause of crop troubles—gizzard compaction with fibrous material, &c.—and consequent disorganization of the digestive system.

The best form of grit is small pieces of sharp gravel, stone, &c. These collect in the gizzard and thus act as teeth for the fowl. Where poultry have free range, and the ground is of a gravelly nature, the birds are afforded an opportunity of picking up all the grit they require, but on clay or sandy soil, even although they have their liberty grit should be provided, and obviously what applies in the latter case applies in greater force where the birds are confined. On the farm, where, say, one hundred fowls are kept, it is surprising how soon they will consume a dray-load of gravel, providing it is sufficiently small for the birds to swallow.

In addition to sharp stone grit, fowls should have free access to broken sea-shell or charred bones for the manufacture of egg-shells. If the annual monetary loss to the Dominion caused by the production of weak-shelled and shell-less eggs, due chiefly to birds having insufficient lime, could be

ascertained, it would be surprisingly large. Not only this, but lime is also an essential bodily requirement for birds of all ages. Growing stock will fail to make sound development and the desired size and quality of bone unless lime in some form is provided throughout all stages of development. If the value of lime to growing birds were better realized by poultry-keepers in general, the proportion of weedy, fine-boned stock now seen would be considerably reduced.

In regard to shell-less eggs, it must not be inferred that the lack of lime is always responsible for these being produced. The overfeeding of rich food, such as meat and meat-meal or condiments (which latter should never be fed to fowls), are often responsible. Where, therefore, ample sea-shell is available to fowls, and eggs with weak shells are being produced, it will be found a wise course to reduce the amount of forcing diet. This does not apply where only an odd bird in the flock may lay imperfectly shelled eggs, for even on the best managed plants, cases may occur owing to a bird being overfat, thus preventing the reproductive organs from functioning in a normal way. Such birds should be located by means of a trap-nest and eliminated from the flock.

Regarding the desirability of providing gravel-grit as well as oyster-shell, it is true that some birds do well on sea-shells alone. As a preventive, however, of liver troubles, crop and gizzard compaction, &c., sharp gravel grit is always advisable, and in the case of the heavier breeds it is essential.

Prevention of Egg-eating.

The production of weak or shell-less eggs not only means a direct loss to the poultry-keeper, but also encourages fowls to acquire the bad habit of egg-eating. Such eggs are easily broken, and once the hens have tasted the substance it will probably not be long before they learn to break the shells of the normal eggs for themselves. The habit of egg-eating is usually a difficult one to break, and preventive measures are the best means of dealing with it. To this end, as previously advised, a plentiful supply of sea-shell should always be in reach of the birds. Ample, properly arranged, and secluded nests should be provided, and care taken that the birds are not unduly forced for egg-production by means of rich stimulating food.

If fowls have acquired the habit of egg-eating a good plan is to provide sufficient dark nests, each in a deep box—say, 15 in. by 15 in.—with about 8 in. of straw chaff. The egg will then fall to the bottom and cannot be seen by the hen, which will not trouble to look for it. Another remedy that usually has the desired effect is to obtain a basket of fresh egg-shells from the baker or confectioner and throw them to the fowls whole; give them all they can eat and keep a supply before them for some days, when the sight of egg-shells will have lost its charm for them.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Use of Queen-excluders.

THE coming month should prove the advantages to be gained by the use of excluders. In the colder districts they are of inestimable value in enabling the beekeeper to finish extracting before the hot weather has altogether departed. Generally speaking, they should only be used during the main honey-flow. All sealed brood should be raised above the excluder, and the queen confined in the brood-chamber on drawn-out combs. After a few days the brood in the super should be examined in case queen-cells have been started, as it is almost impossible to find brood-combs which

do not contain a few eggs, and the bees will often raise queen-cells on brood from which the queen has been separated. The queen will continue to lay on the empty combs provided, and, as the brood in the upper story hatches, the combs will be filled with honey—a great boon to the beekeeper who does not wish to extract brood-combs. By delaying the use of excluders till the main flow has started, one of their chief disadvantages—the promotion of excessive swarming—is largely obviated, as in most localities swarming stops automatically when clover blooms freely.

Extracting Operations.

By the end of December extracting should have begun in the warmer parts of the Dominion, though farther South it may not commence till some little time later. The utensils for handling the honey should be thoroughly cleansed and scalded, and set up in the position they will occupy during the season. Everything should be tested to see that it will stand the strain of the season's work. Extracting is such high-pressure business that there is little time to stop for repairs once it commences in earnest. The uncapping-knives should be sharpened, strainers fitted with clean cheese-cloth, brakes and belts inspected, and all machinery oiled and cleaned, so that matters may run smoothly during the few weeks that the main business of the apiary is in progress.

The honey may be extracted as soon as the combs are three parts capped, and the operation repeated two or three times during the season. In fact, keeping the extractor running from the time the main flow sets in is perhaps the most satisfactory way of dealing with a honey crop, and is to be recommended where there is a possibility of thick honey being gathered. However, in clover districts, when the beekeeper possesses plenty of supers, the honey may be left in the hives till the end of the flow, and all the extracting done at one time. Although this ensures prime, well-ripened honey, it makes the handling of the crop very heavy work, and will give more trouble from robbers, which are always very much in evidence at the end of the season. In addition, in the colder districts heavily supered hives are apt to become chilled during the later part of the summer, and cold honey is much more difficult to extract than warm.

Once the honey leaves the hives it should be handled as cleanly and expeditiously as possible. Two or three zinc trays are a big help in disposing of drips, &c. One placed on the barrow which conveys the supers of combs to the honey-house, and another on the floor of the house to receive the supers prior to uncapping, will save much unpleasantness to clothes and feet. These trays should have small blocks or supports fastened in each corner to raise the supers a little, so that the drippings from burr combs, &c., may be drained away from the bottom edge of the supers. These trays are easily washed at the end of the day and drained dry ready for the next using. The extractor, uncapping-can, and honey-tank when not in use should be kept covered with clean washing covers, and care should be taken that all bees, flies, and other extraneous things are excluded from the honey. From the peculiar nature of honey-production it is impossible to clean utensils day by day as is done with most foodstuffs, and it is imperative that honey be prevented from coming into contact with dirt and foreign substances.

Provision of Supers.

On no account must the beekeeper neglect to provide his swarms with storage-room. If the weather is normal, from ten to fifteen days after a strong swarm is hived it should be provided with a super. Not only is this necessary in order to obtain a surplus, but if it is not done the newly created colony will probably swarm again. A swarm is most vigorous and will usually make more headway than an established colony, and therefore should be encouraged by the provision of ample room. Many beekeepers

deplete their honey crops considerably by failing to realize the fact that early swarms particularly will invariably yield a large surplus in a favourable season.

Ventilation of Hives.

Every care should be taken to provide the bees with plenty of ventilation during the height of the summer. All entrances should be enlarged to their utmost capacity, and where the bees show a tendency to excessive fanning or clustering out the hive should be raised from the bottom-board, and any obstruction such as weeds, grass, &c., cleared away from the entrances. Most important of all, ample room should be provided by means of supers, as the overcrowding of the hive will tend to make the bees loaf if it does not produce excessive swarming.

Foul-brood.

As soon as settled weather sets in the beekeeper should carefully examine his hives for disease, and, if necessary, treat as soon as possible, so as to give his bees a chance to gather a surplus from the main flow. On no account should the operation be delayed until the bees are bringing in large quantities of the nectar that the beekeeper requires for extracting. The "shake" or McEvoy method is the only one advocated, and the combs and frames should be treated and disposed of as soon as possible after the hives are dealt with.

Queen-raising.

The beekeeper should devote all the time he can spare to the important work of replacing old and failing queens, and if his stocks are of good quality he should endeavour to raise as many queens as possible in his own yard. Cells built under the swarming impulse are splendid for this purpose, and there are many ways of artificial queen-raising which are to be recommended. All the cells to be hatched should be given to nucleus hives to care for; queen-cells are seldom a success when introduced to full colonies. As soon as the young queens are mated and laying they should be placed in poor colonies, after killing the old queens, and their places filled by other ripe cells.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetable Crops.

THE planting of the important winter crops of savoy and red cabbage, kale and cauliflower, broccoli and Brussels sprouts, leeks and celery, should now be completed. Seasonal notes regarding these crops were printed in the November *Journal*.

Where the land is moist or the climate sufficiently humid there is considerable growth during the autumn period. Advantage of this may be taken to sow during January late crops of peas, kidney beans, silver beet, shorthorn carrots, globe beet, turnips, spinach, parsley, lettuce, and radishes, thus extending the season for these useful vegetables far beyond the period when the same crops, sown earlier, are quite exhausted. An early-maturing variety should be chosen for the pea crop, and the lettuce would generally be best sown thinly where it is to mature. Silver-beet is specially suitable for dry districts where pests make it difficult to grow good cabbage; the sowing in early autumn will provide leaves for pulling in the spring.

Runner beans should be closely picked and well supplied with water. On dry clay loams and overdrained soils a light mulch of lawn mowings

or litter will greatly assist in keeping the ground in condition. Cucumbers, marrows, and similar crops should also receive generous watering and occasional supplies of liquid manure. Cut the marrows so soon as they are of a suitable size; the flavour is then better than when they are ripe; the crop will also be greater. Thin out the growth where it is crowded, and stop leader growth to induce fruiting.

Continue to spray late crops of potatoes; and where aphis is attacking carrots and crops difficult to spray effectively, dust them with soot or tobacco once a week.

Harvest shallots, garlic, and onions so soon as they mature; ripen them off well; trim them, and store in a dry, cool place.

Harvesting the Tomato Crops.

The earlier outside tomato crops will commence to ripen towards the end of January. The ripe fruit should be gathered systematically—anything overlooked will become overripe and so wasted; it also checks the development of the fruit above it on the plant. Laterals should be removed before they exceed 3 in. of growth, and the leaders should be tied to the trellis or stake as necessary.

Under glass the harvesting of the tomato crop will be at its height. All the ventilators will need to be in operation most of the time now, and even at night a good deal of top ventilation will be required. The least closeness, resulting in a humid atmosphere, will quickly induce the mould fungus disease and other troubles. Close picking and fortnightly applications of a liquid manure composed of "complete" chemical fertilizers in solution should produce a maximum crop. In the absence of a satisfactory recipe try ½ oz. each of nitrate of soda and sulphate of potash, and 1 oz. of superphosphate, to a gallon of water, applying about a quart of the solution to each plant the day after watering. If patchy ripening of the fruit takes place, an increase in the sulphate of potash ingredient should be tried. Careful attention to ventilation and watering are still of fundamental importance, as they always are with crops under glass.

Small Fruit Culture.

Land for a new planting of strawberries should be taken in hand now so soon as it is cleared. Plough or dig the ground lightly, turning in a good dressing of bonedust or other phosphate with good lasting properties, and absolutely clear it of all bad weeds—in fact, by occasional cultivation between the present and planting time, weeds and seeds of all kinds should be destroyed. If that is done, and the ground is well charged with humus, the battle for good crops is more than half won. One of the other important factors is good plants; these should now be in sight. Choose a variety that has been proved suitable to the locality. It is odd and unaccountable how varieties of plants favour certain localities and despise others, even under the most careful treatment. Avoid lavishing care, then, on ungrateful progeny that refuses to crop, by a careful choice of variety. Not only that, but, if possible, also see that the runners (as the young plants are called) are produced from parents of good constitution and performances, for plants vary widely in these respects. And to secure vigorous plants the runners to be allowed to root round the approved mother plant should be limited in number—not perhaps to four or so of the first plants on the runners, as is sometimes suggested, but to such a number that will develop into vigorous plants without manurial assistance in time for the planting season—*i.e.*, February to May. In preparation the land should be worked with a view to gradually getting it into a condition that is fine, smooth, and firm at that period.

Some of the most popular small-fruit crops have now yielded their harvest, and the tendency is to neglect them and give attention to those

crops that are maturing. That will never do; the first thing usually required after harvesting a crop of this class is a certain amount of pruning treatment, good cleansing sprays, and a fertilizer application that will put the plants in good heart for standing the vicissitudes of winter, but without making them so soft and lush as to fall victims to low temperatures. If a crop is allowed to get into poor condition in the autumn it can be generally pulled round in the spring, but it is a very slow business. If, on the other hand, these short-lived crops have come to the end of their period of usefulness they should be pulled out or ploughed under so soon as the crop is harvested, and preparation commenced for further planting.

Plants that carry the fruit on the young one-year-old wood, as do raspberries, loganberries, and black currants, should have it completely removed immediately after fruiting; so that the new wood, which will be the fruiting wood next season, can receive more light and air to ripen it; it will be free from the contagion of what is often diseased old wood, and may be effectively sprayed to prevent the establishment of disease or to destroy any pests that may be present. A bordeaux spray of summer strength, with the addition of arsenate of lead, is generally the most important of these applications now. For manures, a few ounces of phosphates per square yard, and possibly some potash on light land or where growth is inclined to be soft; and if well-decayed farm manure for winter application is not available, a suitable green cover-crop should be sown to maintain that humus in the soil which is so necessary for making other plant-foods available and creating wholesome conditions.

The Homestead Garden.

In preparation for the planting season, which commences in May, and the strong autumn growth which commences towards the end of February, when lawns may be sown to advantage, consideration should now be given to plans for any garden alterations or new work that is to be done. So much that is pleasant, profitable, and wholesome may be obtained at a comparatively little cost in a well-planned garden in this country that the effort is well worth making. Most important is it that it should be well planned. This takes time and thought, which should now be devoted to it, seeing the near approach of those brief periods when action may be taken. Some very fine work of this kind has been accomplished here, but where efforts fall short, as they so often do, it is generally due to the fact that the plans were not fully developed or the ideas do not harmonize with the environment. As nothing in this connection is so important, it should be given the necessary time and thought to work it out and record the details by means of drawings or notes. Then, when it is time to act, operations will be carried out better and quicker, because of the assurance which the plan provides.

Slight alterations often create a vast improvement. The removal of a few trees may reveal an attractive vista and give the scene depth; or where a wide panorama is unfolded from the dwelling, planting the foreground with a few strong groups of trees, shrubs, and plants improves the perspective and gives fascinating distant views a better setting. Where one is so fortunate as to have a natural garden of native bush, it too may frequently be improved, although interference is often considered as an act of vandalism. The only precaution necessary is to see that the spirit of the place is not violated, that our interference does not destroy the harmony.

Among the established trees nikau palms (*Rhopalostylis sapida*) may often be introduced with advantage where the soil is moist and deep. Or in a still more sheltered spot where the soil is always moist the large waving fronds of the tree-ferns may spread their light shade by planting a group

of mamaku (*Cyathea medullaris*) the popular black tree-fern. In a wind-swept place a group of cabbage trees (*Cordyline australis*) will thrive and form a striking note if the land is of fair quality. In a less exposed position a group of selected New Zealand flax (*Phormium tenax*), with straight blades 8 ft. or 10 ft. long and flower stalks correspondingly longer, will not fail to get their toll of appreciation.

Where the bush about the homestead may be considered to lack colour and brightness, a good sized group of kowhai (*Sophora tetraptera grandiflora*) may be planted in the richer ground to create a diversity in the spring, and on the shaded side of the group a number of plants of the Chatham Island lily (*Myosotidium nobile*) would very possibly make their home and assist the effect by spreading their broad shining leaves and bright blue flower in the vicinity of the russet and yellow of the kowhai. For summer display a bank of soil of fair quality may be planted with a generous group of kowhai—red, pink, and white (*Clianthus puniceus*); viewed from below the clusters of flowers with their great hooked keels are then shown off to great advantage. Other subjects that may be useful in adding interest, through the different seasons, to a piece of native bush that may be lacking in character are houhere (*Hoheria populnea*), the finest of the lace barks; the ratas (*Metrosideros*); clematis of sorts, especially puawananga (*C. indivisa*); the climber with scented white flowers, kaiku (*Parsonsia heterophylla*); and the native passion-vine with showy fruit, kohia (*Tetrapathaea tetrandra*).

Where undergrowth is lacking about the margin of the bush, the storms should be excluded by thick plantings on the windward side with olearias, pittosporums, coprosmas, and other shrubs that will stand the gales. To leeward of the bush the margin in nature generally spreads out in interesting groups and isolated specimens that should be imitated. Titoki (*Alectryon excelsum*), karaka (*Corynocarpus laevigata*), ngaio (*Myoporum laetum*), puriri (*Vitex lucens*), kowhai (*Sophora tetraptera*), kohekohe (*Dysoxylum spectabile*), and pohutukawa (*Metrosideros tomentosa*) are suitable for such isolation, as they have the dignity or grace which such a position demands.

Whatever additions or removals may be considered desirable, they should be noted in detail, so that the ground may be prepared and the work completed each in its due season.

—W. C. Hyde, Horticulturist, Wellington

ONE OF THE SMALL-FARM PLAN COTTAGES RECENTLY ERECTED IN THE MANAWATU DISTRICT.

WEATHER RECORDS: NOVEMBER, 1932.

Dominion Meteorological Office.

THE outstanding feature of November's weather was the very low rainfall experienced in most districts. It was a typical spring month in the prevalence of north-westerly winds, gales being recorded on several occasions in the South Island and the southern half of the North. During the past few years these spring north-westers have been rather less prominent than usual, so that last month's experience was rather in the nature of a return to normal. The amount of sunshine was almost everywhere much above the average. Temperatures were rather below normal over most of the North Island and especially in Hawke's Bay, but in Wellington Province and all the South Island, except the west coast, they were above normal. The dry weather and strong winds caused the growth of pastures to be checked, but following on the October rains, feed for stock was plentiful, and in most places showers occurring at opportune times were just sufficient to maintain good conditions.

Rainfall.—The dearth of rainfall was especially marked in the North Island, most localities receiving less than half the average, while in many parts of Auckland Province, including North Auckland, the central interior, and the Gisborne districts, less than a quarter was the rule. Since most of the rain was associated with westerly depressions, the western districts from Kawhia southwards and the high levels fared rather better than the remainder of the country. In the South Island, Nelson, Marlborough, North Canterbury, and Central Otago had a very dry month. Heavy rains occurred on several occasions on the West Coast, and the deficits there were generally small and unimportant. Similar remarks apply to most of Southland and Stewart Island. In South Canterbury heavy local downpours, often accompanied by thunder, occurred on two or three occasions when a southerly change followed a warm north-wester. As a result, most of this area received more than the average fall.

Temperature.—The mean was about 1° F. below normal in Hawke's Bay and about the same amount above it in the South Taranaki Bight area. In other parts of the North Island the departures were small. In the South Island, conditions were about average on the west coast, but east of the ranges the north-westers brought high temperatures, means being 1° F. to 2° F. or even more above normal. A few frosts were recorded, but most of them light. Some damage, however, was done to tender vegetation in certain localities.

Sunshine.—Most stations recorded twenty to thirty hours more than the average sunshine. Nelson had 298·2 hours and Blenheim 287·2.

Pressure Systems.—A series of westerly depressions, six in all, crossed the Dominion during the month. The same type of weather was maintained throughout until the last two days, when disturbances in the Pacific Islands region caused a break in the succession of westerlies. Pressure remained high to the west and low to the east of New Zealand, and strong, cold, southerly winds persisted. Rains were widespread on the night of the 5th to 6th as one of these depressions passed. Many heavy falls were recorded in districts with a westerly aspect.

On the 8th, in association with a fast-moving depression, a good deal of rain was again experienced in western districts. This was one of the occasions, too, when heavy local rains occurred in Canterbury. Thunderstorms were experienced from North Otago to Wellington, and even at a few places farther north. The 26th saw another and even more violent visitation of the same nature. Thunderstorms were

particularly violent in South Canterbury. Some very severe hailstorms occurred in the same district, while violent rains were reported as far north as Kaikoura.

RAINFALL FOR NOVEMBER, 1932, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average November. Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	0·38	7	0·23	2·91
Russell	0·19	4	0·10	2·38
Whangarei	0·88	8	0·39	2·90
Auckland	1·07	14	0·32	3·31
Hamilton	1·49	6	0·85	4·09
Rotorua	0·91	4	0·66	4·14
Kawhia	3·65	12	1·75	4·55
New Plymouth	1·58	11	0·49	4·82
Riversdale, Inglewood	3·94	13	0·92	9·22
Whangamomona	4·27	5	1·52	7·51
Eltham	..	..	..	4·40
Tairua	0·70	2	0·58	3·78
Tauranga	1·71	5	0·80	3·31
Maraehako Station, Opotiki ..	1·79	8	0·75	3·23
Gisborne	0·51	6	0·34	2·92
Taupo	1·00	6	0·52	3·51
Napier	1·08	7	0·41	2·43
Hastings	1·19	7	0·85	1·85
Taihape	2·11	12	0·79	3·52
Masterton	1·87	11	0·52	2·75
Patea	2·39	9	0·80	4·07
Wanganui	2·14	10	0·83	3·27
Foxton	1·50	8	0·48	3·28
Wellington	1·32	7	0·45	2·90
South Island.				
Westport	6·83	16	0·92	8·85
Greymouth	7·58	18	1·25	9·01
Hokitika	8·24	17	1·35	10·73
Ross	11·75	16	2·39	13·95
Arthur's Pass	15·57	14	5·10	16·14
Okuru	12·70	6	4·60	12·99
Collingwood	2·74	8	0·60	7·16
Nelson	1·18	9	0·47	2·99
Spring Creek	0·92	10	0·42	2·45
Hanmer Springs	1·05	4	0·69	3·61
Highfield, Waiau	1·25	6	0·60	2·54
Gore Bay	1·24	7	0·76	2·18
Christchurch	1·03	5	0·51	1·92
Timaru	1·65	6	0·89	1·91
Lambrook Station, Fairlie ..	0·52	2	0·40	1·97
Benmore Station, Clearburn ..	2·25	10	0·78	2·05
Oamaru	2·30	10	1·45	1·91
Queenstown	4·24	12	1·36	2·74
Clyde	0·92	7	0·41	1·35
Dunedin	1·53	17	0·35	3·25
Wendon	1·60	13	0·45	2·78
Gore	3·00	21	0·51	3·23
Invercargill	3·71	21	1·00	4·41
Puysegur Point	6·49	24	2·03	8·35
Half-moon Bay	5·87	22	0·85	5·79

Wellington, 6th December, 1932.

LIVE-STOCK IN NEW ZEALAND.

Land District.	Horses as at 31st Jan., 1932.	Dairy Cows as at 31st Jan., 1932 (in Milk and Dry).	Total Cattle as at 31st Jan., 1932 (including Figures in previous Column.)	Number of Sheep shorn, Season 1931–32.	Number of Lambs shorn, Season 1931–32.	Number of Lambs tailed, Season 1931–32.	Total Sheep (including Lambs) as at 30th April, 1932.	Pigs as at 31st Jan., 1932.
North Auckland ..	30,344	310,186	644,588	1,060,202	165,889	531,663	1,111,338	86,295
Auckland ..	43,810	516,026	982,974	1,553,935	327,751	944,456	1,506,219	169,883
Gisborne ..	16,896	50,198	369,148	2,848,632	540,359	1,259,600	2,953,817	17,946
Hawke's Bay ..	13,436	59,190	228,120	2,784,544	208,298	1,475,832	2,976,354	14,155
Taranaki ..	17,905	239,510	419,600	949,895	148,794	514,149	867,332	52,967
Wellington ..	35,952	242,036	740,518	5,377,276	1,095,246	3,088,187	5,629,455	75,511
Nelson	5,934	30,744	69,577	402,359	11,530	159,742	455,400	14,714
Marlborough ..	6,090	17,506	48,654	1,050,717	16,734	462,353	1,119,897	5,997
Westland ..	2,019	14,559	43,918	72,405	4,734	47,358	81,393	5,789
Canterbury ..	53,584	81,402	188,420	4,503,766	15,432	3,059,797	5,333,399	39,734
Otago	31,009	61,022	148,792	3,321,337	1,609	1,866,942	4,054,595	19,346
Southland ..	24,015	79,691	188,074	2,107,466	6,094	1,564,912	2,602,589	11,079
Totals, 1932 ..	280,994	1,702,070	4,072,383	26,032,534	2,542,470	14,974,991	28,691,788	513,416
Totals, 1931 ..	295,743	1,601,633	4,080,525	27,574,289	*	14,528,309	29,792,516	476,194

* Not available.

—*Census and Statistics Office.*

ESTIMATES OF THE SEASON'S LAMBING.

FOLLOWING are estimates of the current season's lambing in New Zealand computed from estimated average percentages furnished by Inspectors of Stock. Corresponding figures for the five previous years, together with the actual number of lambs tailed therein, are also given for comparison.

Year.	Number of Breeding-ewes.	Estimated Average Percentage of Lambing.	Estimated Number of Lambs.	Actual Number of Lambs tailed.
		NORTH ISLAND.		
1932 ..	9,170,996	89·16	8,177,657	..
1931 ..	9,247,005	86·49	7,998,247	7,813,887
1930 ..	9,312,461	83·19	7,747,274	7,710,370
1929 ..	8,820,536	87·56	7,723,523	7,817,177
1928 ..	8,211,878	84·61	6,948,380	7,286,284
1927 ..	7,905,432	87·28	6,899,861	7,114,057
		SOUTH ISLAND.		
1932 ..	7,892,064	88·42	6,978,494	..
1931 ..	8,361,724	87·13	7,285,914	7,161,104
1930 ..	8,251,714	84·43	6,967,041	6,817,939
1929 ..	7,787,619	89·87	6,998,691	7,070,422
1928 ..	7,322,173	87·74	6,424,887	6,569,674
1927 ..	6,926,298	86·17	5,968,979	6,064,915
		DOMINION.		
1932 ..	17,063,060	88·82	15,156,151	..
1931 ..	17,608,729	86·79	15,284,161	14,974,991
1930 ..	17,564,175	83·77	14,714,315	14,528,309
1929 ..	16,608,155	88·65	14,722,214	14,887,599
1928 ..	15,534,051	86·09	13,373,267	13,855,958
1927 ..	14,831,730	86·76	12,868,840	13,178,972

District Estimates.

The following table gives estimates of the current (1932) season's lambing for the several sheep districts :—

Sheep District.	Number of Breeding-ewes.	Estimated Average Percentage of Lambing.	Estimated Number of Lambs.
Auckland	1,807,831	86·77	1,568,709
Napier-Gisborne	3,835,873	89·31	3,426,156
Wellington - West Coast ..	3,527,292	90·23	3,182,792
Marlborough-Nelson-Westland	778,036	77·40	602,256
Canterbury-Kaikoura ..	3,396,623	92·75	3,150,632
Otago (including Southland)	3,717,405	86·77	3,225,606
Dominion	17,063,060	88·82	15,156,151

—*Live-stock Division.*

Ragwort Control with Sodium Chlorate.—A Pohangina farmer reports that 1 cwt. of sodium chlorate was more than sufficient this year to deal with an area of ragwort which last year required more than half a ton, and he is extremely pleased with the results generally.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith Letters should be addressed to the Editor.

LIME FOR DRINKING-TROUGHS.

W. J. BURTON, Kerepeehi :—

Would you kindly advise me regarding the kind of lime suitable to put in the drinking-troughs for stock, that would kill any parasites which might be in the water and also be beneficial to the health of stock—the quantity per 100 gallons, and how often ?

The Live-stock Division :—

The form in which the lime should be used is burned lime that has been slaked. When lime is put in the drinking-troughs it is not possible for the animals to take in a stated quantity daily. This, however, is not of any great importance. The usual way of giving the lime is to put a shovelful in each trough every few weeks, but before each renewal the trough should be thoroughly cleaned out. The application of lime to the water-troughs will not kill parasites by itself, but when the trough is well cleaned out at every fresh application they are prevented from breeding and infestation is kept down.

DIMENSIONS FOR TOBACCO-CURING SHED.

"FARMER," Wakefield :—

Can you please tell me the dimensions of a 2-acre tobacco-shed with a gable roof ? I want especially to know the height of the shed.

The Horticulture Division :—

The dimensions of a shed for air-curing a 2-acre tobacco crop are as follows : 32 ft. long, 16 ft. wide, and 16 ft. to the eaves. This allows for eight bays of 4 ft. wide, and four tiers of hanging poles. For kiln-curing, the area of 2 acres is too small to fill a standard kiln with ripe leaves, and the time spent on curing leaf in an undersized kiln would be too costly.

FEEDING MIXED MILK TO YOUNG CALVES.

"SUBSCRIBER," Tokomaru :—

Can you tell me whether it is harmful to give mixed milk—*i.e.*, dipped out of vat—to young calves ? I recently lost two calves which, when opened, were found to contain thick hard milk. The milk had been warmed.

The Live-stock Division :—

The system of feeding mixed milk to young calves is not a good one. It is liable to cause digestive troubles, of which you report some evidence. It is more desirable to feed young calves their milk ration either as fresh milk or as sour milk. The holding-vat requires to be cleaned out at regular intervals. It is also advisable to scald the vat from time to time. Attention to these matters and to the cleanliness of other feeding-utensils being used will assist in the reduction of losses. Another common cause of digestive trouble among young calves is the use of too large quantities of milk at this season of the year.

Lime and Superphosphate Mixture.—Throughout the West Coast district of the South Island last year outstanding results were obtained from a mixture of lime and super for manurial purposes, as compared with super alone.